

NASA-TM-82189

Research and Technology Objectives and Plans

SUMMARY

卷之三

65661-184

FISCAL YEAR 1981

RESEARCH AND

TECHNOLOGY PROGRAM

M81-12274

This Supplement is available from the National Technical Information Service (NTIS),
Springfield, Virginia 22161, at the price code A08 (\$14 00 domestic \$28 00 foreign)

INTRODUCTION

This publication represents the NASA Research and Technology program for FY 1981. It is a compilation of the "Summary" portions of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA. The *RTOP Summary* is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. We believe also that this publication can help to expedite the technology transfer process.

The *RTOP Summary* is arranged in five sections. The first section contains citations and abstracts of the RTOPs. Following this section are four indexes: Subject, Technical Monitor, Responsible NASA Organization, and RTOP Number.

The Subject Index is an alphabetical listing of the main subject headings by which the RTOPs have been identified.

The Technical Monitor Index is an alphabetical listing of the names of individuals responsible for the RTOP.

The Responsible NASA Organization Index is an alphabetical listing of the NASA organizations which developed the RTOPs contained in the Journal.

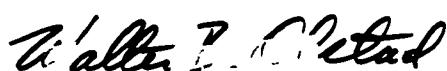
The RTOP Number Index provides a cross-index from the RTOP number assigned by the NASA responsible organization to the corresponding accession number assigned sequentially to the RTOPs in *RTOP Summary*.

As indicated above, responsible technical monitors are listed on the RTOP summaries. Although personal exchanges of a professional nature are encouraged, your consideration is requested in avoiding excessive contact which might be disruptive to ongoing research and development.

Any comments or suggestions you may have to help us evaluate or improve the effectiveness of the *RTOP Summary* would be appreciated. These should be forwarded to

National Aeronautics and Space Administration
Office of Aeronautics and Space Technology
Washington, D C 20546

Attn Edmund L Sanchez, Acting Director
Resources and Management Systems Division (RM-3)



Walter B. Olstad
Acting Associate Administrator for
Aeronautics and Space Technology

Page intentionally left blank

Page intentionally left blank

TABLE OF CONTENTS

	<i>PAGE</i>
Office of Aeronautics and Space Technology	
AERONAUTICS RESEARCH AND TECHNOLOGY BASE	1
Aerodynamics R & T	1
Propulsion R & T	3
Materials & Structures R & T	6
Avionics & Controls R & T	8
Human Factors R & T	9
Multidisciplinary Research	10
General Aviation R & T	12
Low-Speed Aircraft R & T	13
High-Speed Aircraft R & T	15
Transport Aircraft R & T	16
AERONAUTICS SYSTEMS TECHNOLOGY PROGRAMS	19
Materials and Structures Systems Technology	19
Propulsion Systems Technology	19
Avionics and Flight Control Systems Technology	20
Aeronautical Systems Studies	20
General Aviation Systems Technology	21
Low-Speed Systems Technology	21
High-Speed Systems Technology	23
Transport Aircraft Systems Technology	24
Advanced Propulsion Systems Technology	26
Numerical Aerodynamic Simulator	26
SPACE RESEARCH AND TECHNOLOGY BASE	27
Aerothermodynamics R & T	27
Chemical Propulsion R & T	28
Materials & Structures R & T	29
Electronics & Automation R & T	32
Space Power & Electric Propulsion R & T	35
Multidisciplinary Research	38
Information Systems R & T	39
Spacecraft Systems R & T	41
Transportation Systems R & T	42
SPACE SYSTEMS TECHNOLOGY PROGRAMS	43
Space Systems Studies	43
Information Systems Technology	45
Spacecraft Systems Technology	45

	<i>PAGE</i>
ENERGY PROGRAMS	47
Space Utilization Systems	47
Solar Energy Systems	47
Office of Space and Terrestrial Applications	
TECHNOLOGY UTILIZATION-IDENTIFICATION &	
DISSEMINATION	49
ENVIRONMENTAL OBSERVATIONS APPLIED RESEARCH	
AND DATA ANALYSIS	50
SPACE PROCESSING	55
UPPER ATMOSPHERIC RESEARCH	57
TECHNICAL CONSULTATION & SUPPORT STUDIES	58
ADVANCED COMMUNICATIONS RESEARCH	60
DATA MANAGEMENT	61
REGIONAL APPLICATION TRANSFER ACTIVITIES	63
GEODYNAMICS	63
RESOURCE OBSERVATIONS APPLIED RESEARCH &	
DATA ANALYSIS	64
Office of Space Science	
PLANETARY GEOLOGY	69
PLANETARY MATERIALS	69
PLANETARY GEOCHEMISTRY & GEOPHYSICS	70
PLANETARY ATMOSPHERES	71
MARS DATA ANALYSIS	75
INSTRUMENT DEVELOPMENT	76
SOLAR TERRESTRIAL SR&T	77
ADVANCED STUDIES	78
ASTROPHYSICS SR&T	78
PLANETARY ASTRONOMY SR&T	81
LIFE SCIENCES SR&T	83
SOLAR TERRESTRIAL SPACELAB PAYLOAD DEFINITION	86
ASTROPHYSICS SPACELAB SCIENCE PAYLOAD	
DEFINITION	86
SOLAR TERRESTRIAL DATA ANALYSIS	87
ASTROPHYSICS DATA ANALYSIS	88
ASTROPHYSICS EXPLORER STUDIES	88

	<i>PAGE</i>
SOUNDING ROCKETS--SOLAR TERRESTRIAL EXPERIMENTS	89
SOUNDING ROCKETS--ASTROPHYSICS	89
Office of Space Tracking and Data Systems	
SUPPORTING RESEARCH & TECHNOLOGY	89
Office of Space Transportation Systems	
ADVANCED PROGRAMS	95
Indexes	
SUBJECT INDEX	I-1
TECHNICAL MONITOR INDEX	I-41
RESPONSIBLE NASA ORGANIZATION INDEX	I-49
RTOP NUMBER INDEX	I-55

TYPICAL CITATION AND TECHNICAL SUMMARY

RTOP ACCESSION NUMBER → **W81-70216** ← CURRENT RTOP NUMBER
RESPONSIBLE NASA ORGANIZATION → **Langley Research Center Hampton Va** ←
ADVANCED ELECTRONIC COMPONENTS
R L Stermer 804-827-3535 ← TELEPHONE NUMBER
TITLE → **(506-20-23 506-18-13)** ← RELATED RTOPS
TECHNICAL MONITOR →

The objective is to develop advanced electronic devices and components for increased capability and cost efficiency of information handling. Additionally novel device concepts are to be evaluated to enhance information acquisition in terrestrial observation and similar aerospace applications. A balanced approach between research contracts grants and in-house research is used. Theoretical and experimental investigations of materials and device concepts will be conducted in-house. These studies provide a basis for a balanced contractual effort to develop those material and device technologies which have potential of improved performance and cost effective information handling

 ← TECHNICAL SUMMARY

RESEARCH AND TECHNOLOGY

OBJECTIVES AND PLANS

a summary

FISCAL YEAR 1981

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Aeronautics Research and Technology Base

Aerodynamics Research and Technology

W81-70001 505-31-11
Ames Research Center Moffett Field Calif
COMPUTATIONAL METHODS AND APPLICATIONS IN FLUID DYNAMICS
V L Peterson 415-965-5265
(506-51-11)

The overall objective is to develop the capability for predicting complete aerodynamic characteristics of given aircraft shapes and designing new configurations aerodynamically optimized for specific missions to a degree that preliminary concepts can be developed evaluated and screened with less time cost and wind tunnel tests New mathematical methods languages and compilers will be constructed to realize the most effective use of available computer resources Computer programs will be developed to simulate turbulence and to solve complex fluid dynamics problems for the complete spectrum of flight speeds from low subsonic transonic to hypersonic and for steady and unsteady inviscid and viscous flow over two- and three dimensional configurations Fundamental experiments will be performed to verify these codes and to provide the necessary turbulence models The Reynolds number domain will extend from conventional wind tunnel conditions to full scale flight conditions for present and future aircraft The timely transfer of advanced computational aerodynamics technology to the aerospace community will be implemented by developing and disseminating computer codes applicable to practical aerodynamics problems

W81-70002 505-31-13
Langley Research Center Hampton Va
COMPUTATIONAL FLUID DYNAMICS
J C South Jr 804-827-2627
(534-02-13 505-31-33 505-31-23)

The purpose of this research is to provide the fundamental computational methods required for calculating complete aerodynamic characteristics of complex aircraft shapes and for optimizing aircraft shapes for a given mission The primary emphasis will be basic research in numerical and analytical methods coupled with large-scale computers Most computer codes developed in this plan will be of the pilot code class when a method or code is proven as a useful preliminary tool further developments of the codes for more complex configurations

will be supported by RTOPs which are applications oriented such as ACEE and EET Research includes viscous and inviscid flow methods for all speed ranges with near term emphasis on the subsonic-transonic range The main interest is in large nonlinear problems studies include acceleration of iterative methods for large systems of finite difference equations mesh generation methods turbulence modeling and algorithms suitable for vector processor computers such as STAR and CRAY

W81-70003 505-31-21
Ames Research Center Moffett Field Calif

TURBULENCE AND MODELING
L L Presley 415-965-5859
(505-31-51 505-31-31 505-31-41)

The objective is to conduct analytical and experimental studies into complex turbulent flow fields Specifically turbulent flows interacting with shock waves highly curved bodies and general three dimensional surfaces are considered Emphasis is placed on obtaining detailed and accurate experimental data that can be used to guide the development of mathematical models for turbulent structures These mathematical models will subsequently be used to develop fast efficient methods for the prediction of both attached and separated turbulent flows

W81-70004 505-31-23
Langley Research Center Hampton Va
TURBULENT DRAG REDUCTION
D M Bushnell 804-827-4546
(505-31-13)

Research to significantly improve our ability to predict and control the behavior of turbulent shear flows including boundary layers free shear layers and recirculating/vortex flows Theoretical and experimental research to (a) reduce turbulent skin friction drag (b) control stream disturbances in transonic/supersonic/hypersonic tunnels (c) determine sensitivities of laminar boundary layer transition process for application to laminar flow control and (d) improve understanding of physics/structure of turbulent shear flows and turbulence modeling for computational fluid dynamics Drag reduction research investigates moving/compliant walls fixed transverse and longitudinal surface waves and large eddy breakup devices primarily for eventual CTOL transport application Free stream turbulence research develops stagnation chamber treatments and laminar flow and rapid expansion nozzles to improve validity of wind tunnel measurements especially for data where transition and flow separation are present Detailed boundary layer transition studies with controlled input disturbances determine sensitivity of laminar flow control techniques to operational factors such as engine noise suction surface blockage and surface irregularities Detailed experiments using hot wires LV/Ramen Rayleigh scattering and resonant Doppler systems provide data for development and validation of turbulence closure models in three dimensional boundary layers three dimensional free mixing and corner/recirculating/vortex flows

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70005 Ames Research Center Moffett Field Calif AIRFOIL AND WING DEVELOPMENT L L Presley 415-965-5859 (505-31-21 505-31-41 505-31-51)	505-31-31	W81-70008 Langley Research Center Hampton Va CONFIGURATION AERODYNAMICS R T Whitcomb 804-827-2252 (534-02-13)	505-31-43
The objective of this RTOP is to conduct research that will lead to the development of a technology base for the design of advanced airfoils and wings. The scope of the research encompasses both unsteady and steady flow about single element airfoils and steady flow about multi-element airfoils. The single element airfoil program has three main elements: (1) development of advanced computational codes for optimum airfoil design, (2) development of adaptive wall technology for airfoil and wing testing, and (3) theoretical and experimental study of transonic flow about oscillating airfoils. The multi-element airfoil program is focused around coordinated experimental studies which will provide data required for guidance and verification of theoretical work directed toward the analysis of the subsonic viscous flows around multi-element airfoils and wings that are equipped with high lift devices. Emphasis will be placed on merging turbulent shear layers, experimental studies of turbulent separated flow, and the analysis of the three-dimensional flow over finite wings equipped with leading-edge flaps and trailing-edge flaps.		The technical objective of this research primarily is to increase the technology for the development of practical means for improving the aerodynamic performance of high subsonic and supersonic aircraft through the generation and application of an expanded experimental data base and the development and evaluation of improved theoretical and empirical design and analysis methods. Also, technology relative to minimizing trailing vortex induced turbulence will be developed. The expansion of the experimental data base will be accomplished through parametric wind tunnel tests guided by theoretical analyses with emphasis on favorable interference of multiple lifting surfaces interacting vortex flows and vortex lift optimization, favorable interference lift by proper integration of the propulsion system with the airframe, development of improved high aspect ratio supercritical wing and wing-winglet configurations and efficient under-the-wing propulsion system installations, supercritical flow investigation of swept forward wings, and application of variable geometry concepts. Improved analysis methods for both attached flow and vortex flow concepts, methods for predicting complete surface aerodynamic load distribution with emphasis on critical aerodynamic and structural design conditions involving edge separation induced vortex flows will be developed. Further theory and experiment will be used to investigate high lift systems for landing and takeoff and means for increasing the off-design performance of configurations with high cruise efficiency.	
W81-70006 Langley Research Center Hampton Va AIRFOIL DEVELOPMENT R W Barnwell 804-827-4514	505-31-33	W81-70009 Hugh L Dryden Flight Research Center Edwards Calif AERONAUTICS FLIGHT EXPERIMENTS T R Sisk 805-258-3311	505-31-44
The Airfoil Aerodynamics program is to provide analytical methods and computer codes coupled with experimental procedures and test facilities for the design and development of airfoils and airfoil systems in both steady and unsteady flows and to employ these tools in the development of advanced technology single- and multi-element airfoils for all classes of aircraft. The applications include propeller sections and airfoils for fixed- and rotary-wing aircraft and involve the subsonic and transonic speed regimes and laminar and turbulent boundary layers. The program includes (1) the generation of precise theoretical and rapid engineering analysis and optimal design methods which have been verified through appropriate selected experiments, (2) the development of new and improvement of existing airfoil research facilities to improve the range and validation of two-dimensional data, and (3) the generation and documentation of the aerodynamic behavior of new families of airfoils, airfoil controls, and high-lift systems by the use of both theory and experiment in support of US industry and DOD to satisfy specific and special-purpose airfoil needs.		The objective of this RTOP is to provide a continuing research and development effort into the problems associated with the fundamental understanding of fluid and flight mechanics with special emphasis on the relationship to large-scale vehicles operating in a real world environment free of interference effects. These efforts include experimental aerodynamic studies to improve our ability to predict the efficiency of vehicles moving through the atmosphere and to define the effects of Reynolds number, surface condition, excrescences, and local and freestream flow conditions on lifting surfaces and complete configurations. Also included will be investigations in support of or verification of wind-tunnel studies. Experimental research pertaining to laminar and turbulent boundary layer phenomena and on the separation characteristics of turbulent flow over afterbodies will also be conducted as will analytical studies appropriate to support the fluid mechanics disciplines.	
W81-70007 Ames Research Center Moffett Field Calif AERODYNAMIC THEORY/EXPERIMENTAL INTEGRATION L L Presley 415-965-5851	505-31-41	W81-70010 Ames Research Center Moffett Field Calif AERODYNAMIC TEST METHODS AND INSTRUMENTATION G Lee Steinle 415-965-5861	505-31-51
The objective of this research is to expand the aerodynamic technology base and provide a basic understanding of the aerodynamic flow fields about complete wingbody-tail configurations as well as individual components through the useful angle-of-attack range and from subsonic through supersonic Mach numbers. This is being accomplished by the development of new theoretical methods and by the integration of theory and experiment to yield a more complete understanding of the aerodynamic phenomena. The primary theoretical methods under development include a transonic wing-body-tail code using the full potential equations and an advanced linear panel code applicable to both subsonic and supersonic flow. In addition, methods will be developed to combine various calculation techniques to predict more complex flows such as jet induced effects or to numerically optimize aircraft components. The integration of theory and experiment includes the development of techniques to rapidly compare calculated and measured results and to integrate theoretical and experimental procedures to provide a more complete definition of the aerodynamic characteristics.		The general objective of this research is to provide the technology for increased ground-based aerodynamic experimental research capability required to improve prediction of performance and flight characteristics of conceptual or new aircraft designs and the exploration of advanced aerodynamic concepts. Tunnel wall constraints, flow quality and means for simulating higher Reynolds number flow will be investigated analytically and experimentally to improve the quality of test results. To improve the state-of-the-art in non-intrusive measurement capability, advanced laser velocimetric and holographic instrumentation systems will be developed to obtain fundamental fluid mechanic measurements such as mean velocities, turbulence intensities and Reynolds stress components. Infrared camera technology will be explored as a means of locating shock-waves and regions of separation on wind tunnel models.	

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70011 505-31-53

Langley Research Center Hampton Va

EXPERIMENTAL METHODS AND INSTRUMENTATION

R A Kilgore 804-827-3711

The technical objective is to provide the technology for increased ground-based aerodynamic experimental research capability required to improve our ability to predict the performance and flight characteristics of conceptual or new aircraft designs and to permit the exploration of advanced aerodynamic concepts. In-house contract and grant research will be used to advance the state-of-the-art with regard to (1) cryogenic wind tunnel research technology (2) magnetic suspension and balance systems (3) transonic tunnel wall interference (4) improved instrumentation techniques and (5) advanced sensors

W81-70012 505-31-54

Hugh L Dryden Flight Research Center Edwards Calif

FLIGHT RESEARCH INSTRUMENTATION DEVELOPMENT

K F Anderson 805-258-3311

This program will investigate and develop new and improved research flight test measurement capabilities which will more accurately and productively collect flight test data. An inertially based integrated sensor system a miniaturized multichannel pressure sensor system and a high accuracy fuel flow meter are to be developed

W81-70013 505-31-63

Langley Research Center Hampton Va

FULL SPACE REYNOLDS NUMBER TEST TECHNOLOGY

L W McLinney 804-827-2961

The technical objective is to develop the test technology required to fully exploit the unique capabilities of the new pressurized cryogenic wind tunnels in the performance of research and development studies related to advanced aerodynamic design concepts at full scale Reynolds numbers. This objective will be accomplished utilizing in-house contract and grant research to (1) extend development of cryogenic technology and full-scale Reynolds number techniques to insure maximum utilization of the unique research and development capabilities of new Langley National Transonic Facility (2) continue development of technology requirement for sound engineering of models for the high pressure cryogenic environment including establishment of model criteria and (3) provide instrumentation and measurement techniques capable of operating over a wide temperature range with emphasis on minimizing measurement error and time required for minimizing measurement error and time required for data collection

W81-70014 505-31-70

Langley Research Center Hampton Va

POST-SPILL LIQUID HYDROGEN BEHAVIOR

R D Witcofski 804-827-3838

The objective will be to provide the technology for predicting the behavior and character of relatively large quantities of spilled liquid hydrogen the vapor which subsequently forms and any resultant deflagration or detonation. The approach will be to define what are considered to be credible liquid hydrogen spills and to develop analytical models for adequately describing the several phenomena with the modeling guided and validated by appropriate experiments. Key issues will be addressed in a logical sequence to establish early the severity of the hazards problems and the range of variables to be included. Phenomena include the vaporization rate of liquid hydrogen when spilled onto various surfaces (e.g. soil concrete) the time-history character and behavior of the vapor cloud formed as a result of spills and the deflagration and detonation characteristics of hydrogen-air-cloud mixtures. Both in-house and contractual efforts will be required

W81-70015 505-31-83

Langley Research Center Hampton Va

APPLIED MATHEMATICS

W D Erickson 804-827-2471

This RTOP provides for the conduct of basic research in applied mathematics and computer science. The research is carried out by a combination of in-house efforts university research

grants and the continuing operation of the Institute for Computer Applications in Science and Engineering (ICASE) located at the Langley Research Center. The in-house and grant efforts include research dealing with numerical solutions of differential and algebraic systems data analysis computer graphics symbolic and algebraic manipulation data base management programing languages microprocessor software and software engineering. The broad research areas pursued in ICASE include Numerical Analysis Boundary Conditions Application of Computational Techniques and Applied Computer Science

Propulsion Research and Technology

W81-70016 505-32-01

Ames Research Center Moffett Field Calif

NOISE REDUCTION TECHNOLOGY FOR SHORT-HAUL AIRCRAFT

D H Hickey 415-965-5036

The work described in this RTOP will provide the technology for the reduction of noise of short-haul aircraft and will provide through wind tunnel measurements large-scale data on relative velocity effects on noise of modern turbofan and turbojet engines. The FY-81 jet noise program includes the reporting of flight effects on the jet noise of a modified viper engine with mechanical suppressors further analysis of this and other data theoretical studies and completion of the joint programs with ONERA on the development of wind tunnel techniques for noise testing. Work on flight effects on fan noise will continue with analysis of the results from tests of a JT15D engine with instrumented fan rotor. Studies of specific short-haul noise sources will begin. The studies will include wall jets the effect of high loading gradients and propeller installation effects. Work on improved mechanization of flow measuring techniques will continue

W81-70017 505-32-02

Lewis Research Center Cleveland Ohio

PROPELLION NOISE RESEARCH

C E Feiler 216-433-6189

The objectives of this RTOP are to provide data and a technology base for reducing aircraft propulsion-generated and associated noise with minimum weight performance and economic penalties and to develop techniques for accurate prediction of noise levels of operating and future aircraft. The generation and propagation of noise from all engine sources both internal and external are addressed. These include the turbomachinery (fan compressor turbine) core engine (combustor internal surfaces) and the jet noise. Acoustic suppression (duct treatment) is a major element of the work. The work is distributed among basic research that provides knowledge of the fundamental principles and phenomena present in noise generation and propagation applied research that explores concepts and provides a data base and demonstration of technology on full scale engine systems. In-house activities are balanced by a few contractual programs including university grants. In-house facilities include the Engine Fan and Jet Noise Facility (W-2) for model fan and jet experiments several hot and cold flow jet rings one outdoor engine stand capable of full scale engine tests including thrust performance and a small laboratory flow duct apparatus. Forward velocity experiments are conducted in the 9x15 low speed wind tunnel

W81-70018 505-32-03

Langley Research Center Hampton Va

PROPELLION NOISE RESEARCH

H H Hubbard 804-827-3577

(505-35-13 505-41-43 535-03-13 505-33-53 532-06-13)

The objective of this research is to provide a data and technology base for reducing aircraft propulsion generated noise with minimum weight performance and economic penalties and to develop techniques for accurate prediction of ground noise levels of operating and future aircraft. Both theoretical and experimental noise reduction and control studies are involved

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

and work will be accomplished in-house and by grants and contracts. Emphasis in the experimental portion of the program is on laboratory and scale model experiments under closely controlled conditions with supplemental acoustic range and flight vehicle studies for validation theoretical methods and calculations of the sound fields inside ducts with airflow with varying geometry and with and without acoustic liners forward motion effects on inlet noise understanding of jet shear noise and shock cell noise generation and propagation through analytical studies and precision measurements jet shielding of jet noise identification and location of sound sources in flow fields noise generation by viscous flow fields atmospheric propagation including refraction and scattering development and validation of procedures for predicting single event flyover noise exposures from general aviation and CTOL aircraft and helicopters and development of advanced methods of noise measurement and analysis

W81-70019 505-32-05

Jet Propulsion Laboratory Pasadena Calif

BASIC NOISE RESEARCH

Paul F Massier 213-354-3549

The general objectives of this RTOP are (1) to advance the understanding of the fundamental fluid mechanics phenomena associated with noise production and noise transmission in jets and (2) to conceive methods of modifying the fluid mechanics that will reduce the noise radiated from jets. More specifically the objectives for FY-81 are to determine the cause of the excess noise and of the jet oscillations that occur in an underexpanded supersonic jet under flight conditions to advance the understanding of the manner in which a flowing air stream surrounding a jet interacts with the jet and changes the radiated noise both for a free inverted velocity profile supersonic jet and for a jet ejector and to evaluate the effectiveness of jet noise shielding of two or more nearby jets. Experiments of supersonic subsonic and coannular jets are performed at temperatures between 70 degrees F and about 2000 degrees F. These studies are conducted in an anechoic chamber. Simulated flight conditions are established by supplying coannular flow around the primary nozzle. Velocity distributions in the jets are determined from measurements of pressures and temperatures obtained with probes. Shadowgraph and Schlieren photographs are taken for visualization analysis. High-speed (7000 frames/sec) Schlieren movies are also obtained. As an example the high-speed Schlieren movies synchronized with signals received by microphone and hot-wire sensors have been used to determine the significance of the pairing process of large-scale turbulent structures on the generation of noise. Microphones are used in the near-field outside the jet and in the far field to evaluate radiated noise. Nitrogen, helium, argon and other gases of different molecular weights are expanded through coannular nozzles to evaluate the effect of density on inverted velocity profile jets

W81-70020 505-32-12

Lewis Research Center Cleveland Ohio

INLET NOZZLE AND PROPELLER RESEARCH

D N Bowditch 216-433-4000

Improved analytical and experimental design methodology for inlets, nozzles and propellers will be generated to achieve higher performance with increased propulsion system stability. Computer analysis programs for predicting internal and external flows will be synthesized in-house and by contracts and grants. These programs will make it possible to analyze viscous and inviscid flows in two and three dimensions. Basic benchmark testing will be done to define detailed flow phenomena to guide and verify the analysis. Verification experiments will be conducted to verify accuracy of computer codes for design of actual components. Inlet nozzle and propeller hardware will be designed and used to conduct exploratory research in areas that are not presently amenable to analysis. A counter rotation propeller research program will be initiated which will include development of analysis and analysis verification by comparison with test results

W81-70021

505-32-13

Langley Research Center Hampton Va

PROPELLION SYSTEM INTEGRATION

W P Henderson 804-827-2676

Fundamental studies will be conducted to develop an improved understanding of the flow phenomena associated with the integration of the propulsion system into advanced aircraft concepts. Through this research propulsion system integration concepts will be studied that are designed to exploit favorable interference effects which may enhance the wing lift, reduce drag or permit thrust reversing of the exhaust system to improve performance of the aircraft. For the exhaust nozzle investigations will be made to determine means of improving the internal and external performance of both uninstalled and installed nozzles and to explore the integration procedures for incorporating the exhaust system into the fuselage wing or pods. General experimental and theoretical research studies will be conducted to improve the understanding of the flow phenomena associated with nozzle/boattail/jet/empennage and inlet/fuselage. Advanced analytical methods capable of predicting the propulsion system integration effects will be developed. These methods will vary from the simpler, faster, patched methods to the more complex Navier-Stokes solutions. Experimental research on inlets and nozzles will be conducted for correlation with analytical results and design procedures will be developed from this information.

W81-70022

505-32-22

Lewis Research Center Cleveland Ohio

FAN, COMPRESSOR AND TURBINE RESEARCH

C L Ball 216-433-6835

(505-32-52 510-55-11 535-01-12)

Approaches to improve efficiency, operating range, distortion tolerance, durability and reliability, and to reduce weight, volume and cost of the wide variety of fans and compressors required for advanced propulsion systems will be investigated. The objective of the turbine program is the attainment of increased life and improved performance through improved turbine cooling and aerodynamic design methods for both axial and radial flow turbines. Increased emphasis is placed on verifying and demonstrating the capability of internal flow analysis codes for improving the accuracy and reliability of compressor and turbine design systems. Accuracy and reliability of design systems and performance prediction methods are improved through more accurate modeling of stage internal flows. The advanced analytical methods will result in large cost savings by reducing both the time required and risk involved in incorporating advanced components into future engine development program. The work is conducted through in-house contract and university grant efforts.

W81-70023

505-32-32

Lewis Research Center Cleveland Ohio

COMBUSTION AND EMISSIONS REDUCTION RESEARCH

D A Petrash 216-433-6860

(505-32-72 511-55-12)

The objective of the work to be conducted under this RTOP is to evolve and demonstrate the technology required to develop combustors and thrust augmentors for advanced civil and military aircraft engines that will provide improved performance, greater durability, wider operating range and reduced engine exhaust pollutant emissions. The activities in this RTOP include both basic and applied combustion and emissions research and technology for advanced high performance low pollutant combustors. Fundamental combustion studies will be conducted in flame-tube type facilities to gain a better understanding of combustion processes and pollutant formation processes. Applied combustion research investigations will be conducted in segment sector and full-scale annular test facilities and will be aimed at providing design tools for the design of future advanced gas turbine engine combustion systems. As appropriate, studies will be undertaken to evaluate and verify the adaptation of this advanced combustion and pollutant reduction technology to modern aircraft engines.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70024 505-32-42

Lewis Research Center Cleveland Ohio

POWER TRANSFER RESEARCH

W J Anderson 216-433-4000

(505-53-12 505-43-32 511-58-12)

The objectives of this work are to advance the state-of-the art in tribological science and in the technology of mechanical components such as bearings shaft seals gas path seals gears shafts lubricants and lubrication systems Goals are to achieve improved component performance life reliability and efficiency in the high temperature high speed and high pressure environments of turbojet and turbopropeller engines and mechanical power transmission systems Emphasis will be given to an interdisciplinary approach to tribological science to create far term opportunities as well as to satisfy near term goals for both improved component and system performance Analytical techniques for balancing determining and controlling the dynamic behavior of rotating assemblies (shafts bearings dampers seals and aerodynamic components) will be developed and corroborated experimentally to provide better design tools for high speed rotating machinery

W81-70025 505-32-52

Lewis Research Center Cleveland Ohio

COMPUTATIONAL FLUID MECHANICS FOR TURBO-MACHINERY

M J Hartmann 216-433-6906

(505-32-52 510-55-12)

The objective of the computational fluid mechanics program for turbomachinery is to develop understanding and modeling ability for fundamental internal flow performance and to develop analytical and computational analyses to simulate and predict the steady and unsteady flow conditions in advanced fans and compressors and cooled turbines Experiments are conducted for the generation of flow models and for code verification The analysis methods are developed into practical codes for use on NASA and industrial computers Specific objectives include the following originate develop and improve analyses for prediction of both aerodynamic and aeroelastic flow effects in advanced fans compressors and cooled turbines develop new analytical and numerical techniques and models for incorporation into advanced codes build analysis tools into a practical highly useful analysis/design system through improvements and integration incorporate extensive graphics into the analysis codes to maximize understanding of the results develop methodology to enable the user to more rapidly cover the range of all the parameters in the analysis space investigate the use of advanced computers for some of the longer running codes conduct basic experiments to obtain data for the modeling of flows and for code verification and verify models and codes against this experimental data The work is conducted through in house contract and university grant efforts

W81-70026 505-32-62

Lewis Research Center Cleveland Ohio

ENGINE DYNAMICS AND CONTROLS RESEARCH

R G Willough 216-433-6624

The objective is to improve the understanding of propulsion system behavior and to provide an improved technology base for future engine system development Experimental and analytical efforts are undertaken to support the various technical disciplines associated with the dynamic behavior and control of propulsion systems The approach in the system dynamics areas is to conduct research subprograms on advanced civil and military engines Particular emphasis is placed on the dynamic interaction problems encountered when the individual components are combined to form an engine system Subprograms include investigations into the effects of distortion on system stability stall recovery and the effects of various disturbances on system dynamic behavior performance Studies will also be made of new component and system technology for improving fuel efficiency and experimental and analytical research will be conducted to define engine system behavior in the higher frequency ranges (greater than 50-Hz) Control theories and concepts are developed and applied to achieve improved performance safety, and reliability Special control hardware such as servos sensors and actuators are developed

as required Dynamic analysis simulation and experiments are performed to validate the control theories concepts and hardware

W81-70027 505-32-72

Lewis Research Center Cleveland Ohio

FUELS RESEARCH

J Grobman 216-433-6229

(505-32-32 511-55-12 511-59-12)

The potential properties of future aviation turbine fuels derived from both petroleum and nonpetroleum sources such as oil shale and coal will be determined by analytical and experimental synthesis and characterization techniques The effects of these fuels which may have broader properties than currently required on the performance and durability of jet engine components and materials will be determined Sufficient quantities of these fuels must be procured and/or simulated by blending of petroleum-based fuels and will be used to conduct research tests required to evolve the technology that may be needed to use these fuels in current and future jet aircraft engines A joint program has been organized between the AFWAL and Lewis to implement an overall integrated effort to best utilize the technical capabilities of both organizations The program includes both fundamental and applied research activities conducted in-house under grants to universities and under industry contracts Overall coordination with other government agencies such as the USN DOE EPA and with industry will also be maintained in order to provide proper direction and scope to the program as it develops and proceeds

W81-70028 505-32-82

Lewis Research Center Cleveland Ohio

PROPELLION INSTRUMENTATION RESEARCH

N C Wenger 216-433-6646

The programs under this RTOP are directed at developing and demonstrating the technology required for significantly advancing the state of the art in propulsion instrumentation The RTOP focus is on both operational instrumentation for propulsion systems and R and D type instrumentation for component development and tests The activities in these programs include fundamental studies of basic phenomena that relate to instrumentation the design development and demonstration of prototype sensors and instruments and the development and automation of large facility type instrument systems Programs are directed toward developing the following High temperature transducers and high temperature electronic devices for use in instrumentation systems for future controls engine monitoring systems and R and D applications a wide variety of sensors (surface temperature heat flux strain etc) for measuring critical propulsion system component parameters particularly those required for hot section durability studies and a number of laser based coherent optical techniques (laser anemometry holography etc) for measuring detailed flows in a variety of situations that are required for verifying computational fluid mechanics models

W81-70029 505-32-92

Lewis Research Center Cleveland Ohio

ADVANCED ENGINE SYSTEM CONCEPTS

R J Weber 216-433-4000

New or improved analytical techniques will be derived for estimating the cycle performance weight and other characteristics of advanced engines Also studies will be performed of new approaches to the design of components or complete engines that will yield better performance

W81-70030 505-32-93

Langley Research Center Hampton Va

HYPersonic PROPULSION RESEARCH

R A Jones 804-827-3772

Program is aimed at developing an understanding of the fundamental process of mixing and combustion in supersonic flows for application to airframe-integrated airbreathing propulsion systems from Mach 3 to Mach 10 Theoretical and experimental studies are conducted in fuel injection turbulent mixing of fuel and air subsonic and supersonic combustion and three dimensional turbulent reacting flows in ducts of complex geometry having lateral pressure gradients in order to advance methodology

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

for design and performance prediction techniques. Component investigations are conducted in Langley facilities on inlets which may be applicable to several types of engines and combustor and nozzles for modular scramjet engine concepts. Research on subscale boilerplate engine modules is conducted at conditions simulating flight at Mach 4 and Mach 7 conditions in Langley propulsion facilities. The in house research is augmented in several areas by R and D grants and contracts. This program is focused on providing the basic technology for lightweight fixed geometry airframe-integrated scramjet engine modules using a dual mode of H₂ fuel injection to control mixing and combustion over a wide range of flight speeds. This technology will be applicable to efficient propulsion for either cruise aircraft accelerating and maneuvering aircraft airbreathing space launch vehicles or with hydrocarbon fueled high speed highly maneuverable missiles.

Materials and Structures Research and Technology

W81-70031

505-33-12

Lewis Research Center Cleveland Ohio

METALLIC/CERAMIC MATERIALS

Hubert B Probst 216-433-4392

(506-53-12 510-53-12 510-57-12 505-32-92)

The objective of this RTOP is to provide the technology base for improved materials (alloys, coatings and ceramics) and processes for use in advanced air breathing propulsion systems particularly for aeronautical applications. The RTOP has two major program elements: high temperature materials and environmental protection. In both elements materials and processes are sought that offer improvements on technical performance and economy in terms of total life cycle costs. In the high temperature materials portion the classes of materials investigated include oxide dispersion strengthened alloys, single crystals, fiber reinforced superalloys, powder metallurgy superalloys, superalloys of low strategic material content, and advanced ceramics in the Si₃N₄ and SiC families. Specific phenomena such as creep, fatigue, crack propagation, grain growth, and sintering are studied. In the environmental protection portion of the RTOP, corrosion protective coatings and thermal barrier coatings and coating processes are investigated. The phenomena of oxidation, hot corrosion, erosion, their interactions, and ultimate effect on coating/alloy system life are studied. In both program elements basic research is conducted in house and by university grants. Results of these basic efforts provide guidance for the more applied work conducted in house and by industrial contracts. Emphasis is on materials and processes relevant to aircraft gas turbine blade, vane, disk and seal applications. Ultimately promising materials and processes become candidates for the MATE program.

W81-70032

505-33-13

Langley Research Center Hampton Va

ADVANCED ALUMINUM ALLOYS

Bland A Stein 804-827-3354

(505-33-23)

The objectives of this RTOP are to identify thermomechanical processes for improvement of mechanical properties and durability of advanced aluminum alloys through basic understanding of the microstructural behavior and to demonstrate the advantages of these materials for commercial transport applications. The results of thermomechanical process development on advanced whisker-reinforced powder metallurgy and lithium-bearing ingot-metallurgy aluminum alloys will be evaluated in fatigue fracture and selected environmental degradation tests and by metallurgical analysis of coupon specimens and structural subelements. The technology from this program will permit significant reductions in mass and improved durability and integrity of commercial transport aircraft structures while retaining conventional aluminum alloy component fabrication technology.

W81-70033

505-33-21

Ames Research Center Moffett Field Calif

FATIGUE DAMAGE AND ENVIRONMENTAL EFFECTS IN METALS AND COMPOSITES

H G Nelson 415-965-6137

An experimental and analytical program will serve as a basis for the development of reliable life prediction methods applicable to graphite/epoxy composite and metallic aerospace structural materials. For composite materials a modification of the time-temperature superposition principle (often used to describe the time-dependent behavior of elastomers) is applied to the behavior of complex laminates through the use of a lamination theory. Using a similar superposition approach the correspondence between stress, moisture, temperature and time are being established with the ultimate goal of the development of an accurate constitutive relationship. The ranges of applicability of this mechanics approach are being established through mechanistic investigations. For metallic materials three different approaches to life prediction are used which correspond to the three stages of fracture: crack initiation, subcritical slow crack growth, and rapid unstable failure. A statistical approach is used for crack initiation for this is a somewhat random process. Factors being considered are mode of loading, the environmental influence and metallurgical parameters both independently and together (potential synergistic influences). Kinetic characterization of the slow crack growth stage of fracture is being accomplished through the application of fracture mechanics techniques. The rate processes will be identified which control slow crack growth such that the limits of applicability can be established and the kinetics of the process may be hindered. Unstable rapid fracture is being characterized through the application of elastic-plastic fracture mechanics.

W81-70034

505-33-22

Lewis Research Center Cleveland Ohio

LIFE PREDICTION

Marvin H Hirschberg 216-433-4000

(510-57-12)

The major objective is to obtain a better understanding of the fatigue and fracture behavior of materials and to develop and verify methods for predicting the life of aerospace structures and components of propulsion systems when subjected to complex time-dependent patterns of temperatures and cyclic loads.

W81-70035

505-33-23

Langley Research Center Hampton Va

LIFE PREDICTION FOR COMPOSITE MATERIALS

Robert T Swann 804-827-2969

(505-33-33 533-01-13 506-53-23)

The objective of this research is to develop the capability to predict the useful lifetime of composite materials in aircraft service environments. Goals of the research include formulation of a suitable theoretical framework for life prediction, experimental validation of the concepts involved and development of the ideas and the instrumentation needed for inspection and damage identification. Studies will be undertaken to identify and characterize damage and damage growth mechanisms. The more basic studies include precise experiments to clarify the processes involved in damage and fracture as well as tests designed to establish the physical basis for variability in material properties through ultrasonic techniques. The understanding acquired in these studies will be used to develop tests which characterize impact damage and impact resistance of composite materials. Effects of moisture and other environmental constituents on bulk material and bonded joints will be determined and validated. Accelerated test techniques will be developed. Simple specimens will be tested to determine the sensitivity of fatigue life to the loads in transport aircraft load spectrum and results of these tests will guide the development of test spectra that will maximize the efficiency of large scale tests.

W81-70036

505-33-31

Ames Research Center Moffett Field Calif

FIRE RESISTANT MATERIALS

A H Heimbuch 415-965-6274

(505-44-21 534-05-11 534-03-11)

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Research will be performed to provide tough thermally stable and fire resistant polymers to serve as candidate materials for a variety of applications in the aerospace field. The main emphasis is to design polymers for use in primary and secondary composite structures transparent films and windows foams and adhesives. Objectives include the development of new matrix resins and improved fibers which will be used for the preparation of advanced composites for aircraft structures. The control of electrical conductivity in modified carbon fibers for use in composites will also be studied with an extension of the study toward photovoltaic materials. The use of polymer grafts and copolymer blends will be investigated as possible approaches to the development of better matrix resins for composites of high fracture toughness. Polymers to be investigated for resin matrix systems include modified polystyrylpyridine (PSP) fluorene-modified epoxies phenolic novolac and resole modified bismaleimides and the aromatic polyether etherketone (a tough thermoplastic). Polymers which are considered for photovoltaic doped systems include polyacetylene and polyparaphenylenesulfide. In addition computational chemistry will be applied to large atomic cluster arrays as models for polymeric macromolecules.

W81-70037 **505-33-32**

Lewis Research Center Cleveland Ohio

COMPOSITES FOR PROPULSION COMPONENTS

Charles P Blakenship 216-433-6922

(505-33-62)

The overall objective of this research is to identify and evolve polymer matrix and metal matrix composite materials and processing technology with potential for aeropropulsion components having lower weight reduced cost and greater reliability. Composites being considered include resin matrices reinforced with fibers of boron Kevlar glass graphite and aluminum matrices reinforced with fibers of boron alumina and graphite. In the area of polymer matrix composites emphasis is placed on identifying processible high temperature resins, a methodology for chemical characterization of PMR polyimides and tougher matrix resins. In metal matrix composites emphasis is placed on improving key composite properties such as impact resistance and on evolving low cost fabrication processes. Potential applications for the composites technology include both static and rotating turbine engine components.

W81-70038 **505-33-33**

Langley Research Center Hampton Va

COMPOSITES

N J Johnston 804-827-3041

(505-33-23 506-53-23)

The objective is to exploit the full weight reduction potential of highly loaded composite structures. The approach is to improve matrix properties damage tolerant concepts analytical predictive methods and understanding of aging effects. Structural resins and adhesives with improved toughness moisture resistance processability and thermal performance will be synthesized. Fundamental factors which control toughness and damage tolerance in resins and composites will be determined. Impact damage and residual strength will be measured and modeled mathematically. Fatigue/fracture problems in full scale composite wing panels will be ascertained. The effectiveness of bolted composite joints and woven buffer strips will be studied. Using advanced structural concepts and design methods flat curved and stiffened structures will be made and tested in compression tension combined loads and after damage. Analytical methods will be developed to predict properties. Long-term durability under expected service environments will be studied using ground-based and flight service exposure. Accelerated tests and predictive analytic methods will be emphasized. Another objective is to lower costs and increase reliability by developing effective repair procedures and advanced processing and joining techniques.

W81-70039 **505-33-52**

Lewis Research Center Cleveland Ohio

LOADS, DYNAMICS AND AEROELASTICITY

G V Brown 216-433-6920

(505-33-22 505-33-62 505-33-72)

The objective of this program is to develop improved methods

of calculating loads stresses and deflections in aircraft turbine engines so that the structural design of an engine can be based more on design calculations and less on testing and rebuild procedures. There has been a marked increase in speed and capacity of computers in recent years. New methods will be developed under this program which can take advantage of these increased computer capabilities. The approach will be to develop mathematical models of the engine. These models will take into account both the interactions between components and provide a more comprehensive treatment of the internal degrees of freedom of these components. Steady state and transient situations such as blade loss will be addressed. The efficiency of special purpose computers with hard-wired solution algorithms for greatly increased speed and of graphical display methods to facilitate input and output of structures problems will be evaluated.

W81-70040

505-33-53

Langley Research Center Hampton Va

LOADS, AEROELASTICITY, AND STRUCTURAL DYNAMICS

W H Reed III 804-827-2265

The objective is to develop and validate improved methods for the analytical determination of loads structural response and structural stability of aerospace systems considering the dynamic and aeroelastic characteristics of the systems and structural interactions with flight control subsystems and to use these methods in the development and evaluation of techniques for eliminating or minimizing flutter buffer noise and other undesirable response phenomena and for the enhancement of performance ride quality crash safety and service life. Research will be conducted to provide more accurate unsteady aerodynamic theories particularly in the transonic range. Advanced aeroelastic analysis methods will be evaluated and validated by both wind tunnel tests and flight tests using the DAST concept (Drones for Aerodynamic and Structural Testing). Emphasis will be on measurements of transonic aerodynamic loads and flight validation of active control systems for load alleviation and flutter suppression. A decoupler-pylon concept for wing store flutter suppression will be evaluated in flight tests on a fighter airplane. Basic wind tunnel flutter studies will be used to gain a better understanding of the flutter characteristics of advanced aerodynamic configurations. Analysis/synthesis methods will be developed for use in design support of future aircraft with advanced features such as active controls and aeroelastically-tailored wings and empennage. Improved methods for the analytical determination of structural response to noise will be developed and these methods will be used in the development and evaluation of techniques for minimizing noise transmission for the enhancement of ride quality. Advanced analysis and synthesis capability for predicting and improving transport aircraft crashworthiness and occupant survivability will be developed.

W81-70041

505-33-54

Hugh L Dryden Flight Research Center Edwards Calif

FLIGHT LOADS AND AEROELASTICITY

A L Carter 805-258-3311

This RTOP has three primary purposes (1) to study unsteady aerodynamic loads and flutter suppression at transonic speeds using an RPRV aircraft (2) to study airload measurement techniques on large flexible aircraft and (3) to evaluate in flight a decoupler pylon system for preventing flutter of aircraft wings with external stores.

W81-70042

505-33-60

National Aeronautics and Space Administration Washington D C

INTERDISCIPLINARY RESEARCH IN COMPOSITE STRUCTURES

Charles Bersch 202-755-2364

The objective is to conduct research in the application of advanced composite materials in the design and fabrication of aerospace structures. The research will be performed by an educational institution utilizing interdisciplinary capabilities in materials engineering mechanical engineering aeronautical engineering civil engineering and chemistry. Research projects will involve composite materials characterization structural

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

integrity structural analysis and design manufacturing techniques and system applications

W81-70043 **505-33-62**
Lewis Research Center Cleveland Ohio
INTEGRATED ANALYSIS AND SYNTHESIS
C C Chamis 216-433-4272
(505-33-22 505-33-52 505-33-72)

The general objective of this program is to develop accurate and affordable advanced computational methods computational facility architectures advanced and generic design concepts and the methodology and technology needed to support the structural synthesis of engine components and systems in an integrated multidisciplinary design environment Generic design concepts and the requisite methodology will be developed for the most promising applications of advanced materials and composites in engine systems The requisite methodology includes advances in all facets of integrated analysis/synthesis as well as the development of integrated modular computer programs (including software, firmware and hardware) streamlined for engine systems analysis/design/synthesis The program is balanced among in-house grant and contract efforts distributed as follows 40% in-house 20% grants and 40% contracts

W81-70044 **505-33-63**
Langley Research Center Hampton Va
AERONAUTICAL STRUCTURAL DESIGN METHODS
J Sobieski 804-827-3451
(533-01-13 510-54-13)

The objectives are to provide advanced analysis and synthesis capability for multidisciplinary evaluation and design of control configured structurally and aerodynamically advanced aerospace vehicles and to exploit advances in computer-aided design hardware and methodology The approach will be to develop integrated multidisciplinary analysis and synthesis methodology with emphasis on applications of advanced technologies including composite structures configuration aerodynamics and active controls and to define and demonstrate microprocessor and minicomputer hardware configurations to improve the efficiency for structural calculations

W81-70045 **505-33-72**
Lewis Research Center Cleveland Ohio
HIGH TEMPERATURE STRUCTURES
R H Johns 216-433-4380
(505-33-22)

The general objective of this program is to develop the technology necessary for the application of advanced materials and design concepts to aircraft turbine engine structures and to develop aerothermomechanical structural analysis and design methodology primarily for hot section components of advanced high-bypass commercial engines Included within the general objective is the development of analytical models and advanced computer graphic modeling techniques necessary for efficient and affordable stress-strain analysis as a function of time and temperature for complex components and load history conditions Emphasis will be on the development of structural design and analysis methods which will provide reliable lightweight engine structures having specified durability and life under the extreme environmental conditions experienced in the hot section of an advanced engine Engine system structural models will be developed to provide analytical capability to account for distortions and displacements due to transient and steady-state thermal and mechanical loads

W81-70046 **505-33-73**
Langley Research Center Hampton Va
HIGH TEMPERATURE AERONAUTICAL STRUCTURES
S C Dixon 804-827-3423
(506-53-33 506-53-63)

The objectives are to develop structural concepts for future hypersonic aircraft verify promising concepts by fabrication and tests of realistic structures and to devise analysis and design methods applicable to such concepts Research and development is being carried out to establish a technology base from which the structures and thermal control systems for hypersonic vehicles

can be designed Included in the program are fabrication experimental and analytical efforts on both airframe and supersonic combustion ramjet (scramjet) structural concepts which will withstand the rigors of extended and repeated use in a hypersonic environment Research data obtained from both laboratory and wind tunnel experiments will serve to verify analysis and design methods, identify promising concepts and provide guidance for future research efforts The effort is focused primarily on convectively cooled concepts An actively-cooled panel program has been underway for several years Testing of three panel concepts and documentation of results should be complete by the end of FY-1981 Design studies of scramjet structural concepts have identified promising approaches and development and verification of fabrication techniques of various components constitute the major effort under this RTOP

Avionics and Controls Research and Technology

W81-70047 **505-34-11**
Ames Research Center Moffett Field Calif
NAVIGATION AND GUIDANCE SHORT-RANGE OPERATIONS
H Erzberger 415-965-5450
(532-01-11 532-02-11)

The objective is to conduct research on advanced guidance and navigation concepts for increasing the safety and efficiency of short-range aircraft operating in various air traffic control environments This objective will be approached in three tasks The first is to develop efficient on-board computer algorithms for generating and tracking minimum fuel 4D trajectories in a high density airspace A flight path management system incorporating such algorithms will be designed and evaluated in a simulated ATC environment The second task is to develop ATC flow management procedures and algorithms that exploit the potential of both advanced airborne guidance and ground computer capabilities to increase capacity and efficiency The integration of the airborne and ground procedures will be studied in a controller-pilot interactive ATC simulation The third task is to investigate several low cost navigation and state estimator concepts for closed loop guidance and control applications

W81-70048 **505-34-23**
Langley Research Center Hampton Va
COCKPIT AVIONICS GENERIC
J J Hatfield 804-827-3291
(534-04-13 504-41-63 505-34-43 505-34-13)

Development of advanced cockpit avionics technology (such as electronic display generators and media input/output techniques and systems integration techniques) coupled with advances in human factors research can greatly improve the flight deck of advanced jet transport aircraft cockpits of general aviation aircraft and crew stations of other types of aircraft This technology has the potential to reduce clutter and associated workload and to improve performance safety and flexibility while reducing avionics life-cycle cost Work done under this RTOP will develop cockpit requirements for future civil missions identify candidate concepts for future cockpit systems development technology for implementation of these concepts and perform proof-of-concept experiments using hot bench simulator and flight testing Technolog developments will be focused on electronic display media such as the CRT electroluminescent and liquid crystal panels on microprocessors display generation, multifunction switching and touch panel I/O techniques and on subsystem/system integration techniques Experimental testing will be performed in the early phases of the program on laboratory and engineering models Testing will then progress to prototypes and subsystems testing and culminate in the testing validation, and demonstration of an integrated cockpit system

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70049 505-34-31
Ames Research Center Moffett Field Calif
AIRCRAFT CONTROLS RELIABILITY ENHANCEMENT
C T Snyder 415-965-5567
(512-54-11 505-36-11 505-42-31)

Advanced control technology will be explored and developed to enhance the reliability of future aircraft flight control systems. This will include in-house study activities and University grants oriented towards a unified methodology for the analysis and design of redundancy management and which will be implemented using digital techniques. In-house activities will establish the potential of new concepts for redundancy identifying the sensor/controller/software combinations pertinent to various regions of the flight envelope and determine the control logic for transition between control modes from normal operation to failure conditions. University grants will be awarded to support promising research in the field and to keep NASA abreast of new advances in control theory pertinent to analysis and synthesis of redundant flight control systems

W81-70050 505-34-32
Lewis Research Center Cleveland Ohio
ELECTRONIC AIRCRAFT ENGINE CONTROL
D I Drain 216-433-6480

The objective is to develop a technology base for designing highly reliable digital electronic controllers needed for future aircraft turbine engine powerplants. Present engines use hydromechanical controllers which exhibit extremely high reliability while operating in a severe environment on the side of the engine. Electronic controllers needed for the control complexities of future engines must approach present reliability levels for acceptance into service. The approach will be to employ the latest very-large-scale-integrated (VLSI) circuitry technologies in multiple processor fault tolerant architectures. This approach will need not only hardware developments but also software technologies for accomplishing a fault tolerant controller. The reliance upon a computer-based software control will require studies intended to develop techniques for insuring the integrity and reliability of needed high technology software

W81-70051 505-34-33
Langley Research Center Hampton Va
AIRCRAFT CONTROLS THEORY AND TECHNIQUES
J R Elliott 804-827-4681
(505-34-13 505-41-63)

The objective of this effort is to develop fundamental concepts, design methods and application tools necessary for the safe and efficient operation of advanced aircraft to establish integrated design methods for advanced guidance and control systems to develop candidate integrated systems configurations with emphasis on active control aircraft and to validate system design procedures, operation and performance. The approach is to conduct studies leading to validation of procedures for mathematical modeling and analysis techniques of flexible aircraft with active controls to develop and demonstrate computer programs which will provide an optimized control system design to develop advanced guidance and control system techniques which are practical and consistent with available onboard aircraft instrumentation to develop aircraft parameter estimation algorithms with improved accuracy and computational efficiency to develop and validate advanced theoretical concepts for control of aircraft and their trajectories and to conduct research leading to a scientific/engineering data management system for use in computer-aided design studies of active control aircraft

W81-70052 505-34-34
Hugh L Dryden Flight Research Center Edwards Calif
AIRCRAFT CONTROLS FLIGHT SYSTEMS CONCEPTS
K J Szalai 805-258-3311
(512-54-14 505-34-31 505-34-33)

This RTOP aims to study, develop and test cost effective methods of implementing advanced reliable flight control systems that will permit greater operational capabilities and increased performance of future aircraft without a reduction in safety and to conduct ground and flight tests of new concepts to verify design methods and validate performance predictions

The emphasis will be on the application of microelectronics, analytic redundancy management, advanced control algorithms, optical communication and distributed processing to highly reliable fly-by-wire control systems. In addition, analysis and modeling of lightning test data will be accomplished to provide design criteria and valid test methods to ensure immunity of advanced hybrid fly-by-wire control systems to electromagnetic hazards. The F-8 Iron Bird and flight vehicle facility will be used to provide experimental data to validate theoretical results

W81-70053 505-34-37
Lyndon B Johnson Space Center Houston Tex
AIRCRAFT CONTROLS ELECTROMECHANICAL ACTUATOR TECHNOLOGY
J T Edge 713-483-2392
(505-34-34 505-34-43)

State-of-the-art magnetic materials and solid state switching components make feasible EM (electromechanical) actuators capable of performing the primary flight control actuation task(s). When applied to aerospace vehicles the results are the replacement of a large, heavy, difficult to maintain hydraulic system with a lightweight, efficient and easily maintained EM actuation system. The development objective is the extension and demonstration of the EM actuator technology developed at the Johnson Space Center to a representative aircraft application. This extension will include the design and fabrication of a lab system for extended test and evaluation

W81-70054 505-34-43
Langley Research Center Hampton Va
INTEGRATION AND INTERFACING TECHNOLOGY
W Mace 804-827-3745
(505-34-31 505-34-34 505-44-13 512-54-11 512-54-14)

Aircraft of the 1990-2000 period can be more efficient and profitable as a result of technology advances already proposed by technologists. The objective of this effort is to accelerate the acceptance of these advances by reducing the risk of the new technology. New directions being taken by emerging safety and performance assessment methods for complex electronic systems offer expanded technical insight and will be the basis for the future validation process. A methodology will be developed for integrating avionic and control functions. Modeling will continue for reliability, safety and performance assessment. Candidate system architectural concepts will be identified and technology capable of contributing to improved system characteristics will be developed. Lightning effects on digital avionics will be investigated and evaluation approaches developed

Human Factors Research and Technology

W81-70055 505-35-13
Langley Research Center Hampton Va
HUMAN RESPONSE TO NOISE
D G Stephens 804-827-3561
(505-33-53 505-32-03 505-41-43 505-35-13 532-06-13)

The objective of this research is to define and quantify stimulus, environmental and human factors responsible for affecting community and passenger response to aircraft noise and operations. Research studies will consist primarily of laboratory tests to subjectively evaluate the properties of aircraft-generated noise that are responsible for causing annoyance. The laboratory program is aimed at developing criteria for evaluating the noise from single aircraft events as well as evaluating the response to longer term, multiple aircraft exposures. Subjects will experience the recorded noise of aircraft or the synthesized noise of future systems under simulated indoor, outdoor and aircraft interior conditions. Various psychophysical measures such as annoyance and speech interference will be used by the subjects to judge or rate the noise. The resulting single event dose-response relationships will be directly applicable to the engineering assessment of source noise modifications and to aircraft certification procedures whereas the multievent results will be

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

applicable to the evaluation of aircraft/airport operations. Field studies will be directed toward the development of a predictive model of community acceptance which includes in addition to the details of each noise level the frequency of events the time of day/night and the population distribution. The model will be formulated such that it can be used to assess the noise abatement resulting from A/C modifications A/C operations and land use strategies.

W81-70056 **505-35-21**

Ames Research Center Moffett Field Calif

FLIGHT MANAGEMENT SYSTEMS

H P Klein 415-965-5094

(505-35-31)

This program will investigate flight management and crew/system interaction mechanisms and requirements for current and advanced aircraft. Specific objectives are to develop (1) procedures for the measurement and assessment of aircrew performance for current and future systems under varied conditions of automation, ground authority, traffic complexity and environmental conditions (2) guidelines for the design and use of automated systems in the cockpit (3) new technology for improved current and future man-system information interfaces such as navigation charts, operating manuals, warning and status annunciation systems, pilot input systems, head-up displays and panel displays and (4) new technology and methodology for aircrew training. To accomplish these objectives, manned full-mission and part-task simulations will be conducted to evaluate performance and workload measurement methodology and aircrew perception and decision-making functions in a variety of tasks and mission scenarios. In-house studies in conjunction with contracts and university grants will be used to develop principles of optimal crew utilization and to evaluate training effectiveness. Collaborative studies with the FAA, industry and the military will be pursued to evaluate subsystems such as alerting and warning systems, head-up displays, cockpit display of traffic information and crew procedures.

W81-70057 **505-35-23**

Langley Research Center Hampton Va

CREW INTERACTION WITH ADVANCED FLIGHT SYSTEMS

A A Spady 804-827-3871

(513-52-03)

This research activity will be directed toward the definition of crew responsibilities and interactions, flight procedures and control and display requirements for the future civil air transportation system of the 1980-1990s. The approach is to develop the capability of quantifying visual information processes and apply this capability to understanding how a pilot functions and interacts with his flight environment. This requires participation in the evaluation of current and future flight and ATC systems development of display and workload evaluation methods, basic visual human factors research and the development of hardware and software for measuring and analyzing pilot's physiological functions. These efforts are aimed at developing parameters that can be used as quantitative measuring tools for assessing and defining (1) crew performance (2) the content and format of displays and (3) flight procedures for the 1980-90 aircraft.

W81-70058 **505-35-24**

Hugh L Dryden Flight Research Center Edwards Calif

HUMAN FACTORS FLIGHT RESEARCH WITH HIGH PERFORMANCE AIRCRAFT AND RPVs

D T Berry 805-258-3311

This program utilizes RPVs (remotely piloted vehicles) and high performance aircraft, particularly those with a single pilot, to develop and evaluate the human factors aspects of highly integrated man/machine systems. The pilot task load will be analyzed and correlated with the psychophysiological response of the pilot during the flights of manned and remotely piloted high performance aircraft. These vehicles will have advanced capabilities such as high authority augmentation systems, direct lift and sideforce and fuselage pointing. While developing and utilizing RPVs and piloted aircraft flight test techniques, cockpit configurations will be systematically varied while the effects

upon pilot response are tabulated. Both controls and display systems will be varied during the cockpit development. This will include evaluation and optimization of remote visual systems.

W81-70059

505-35-31

Ames Research Center Moffett Field Calif

SIMULATION TECHNOLOGY FOR AERONAUTICS

H P Klein 415-965-5094

(505-35-21 505-42-41)

The general objective of this research and development activity is to provide a scientific and technical base that can be used as a resource to develop valid, reliable and economical simulators for aeronautical research, development and crew training. Specific objectives are (1) to develop human factors principles that can be used to evaluate and guide the effective utilization of flight simulators and automated training devices and (2) to develop advanced hardware and software concepts for high fidelity simulation of vision and motion environments. The first of these two objectives will be met by continuing the study of human factors of reduced visibility scene technology, initiating a study of peripheral cue requirements, refining an analytical method for evaluating simulator motion performance based on a human sensory processing model and studying the potential for improving pilot training through the use of advanced simulation technology and compatible instructional strategies. The second objective will be met by developing validation techniques for evaluation of simulators and simulation aircraft models, developing techniques and concepts for simulation hardware such as computer graphics displays, heads-up displays and motion systems, and developing computational techniques that increase the effective speed of digital simulation computers.

W81-70060

505-35-33

Langley Research Center Hampton Va

APPLICATION OF FLIGHT SIMULATION TECHNOLOGY

R L Bowles 804-827-3304

This RTOP's objective is the development and application of a technology base that will permit the economical and reliable substitution of simulators for actual flight operations in support of Langley's research programs. It will cover both in-house and contractual studies which address current constraints in Langley simulator equipment in the formulation and validation of simulation math models and in the linkage of hardware/software systems to provide in the closed-loop pilot/simulator environment effective simulations. Principal tasks for FY 1981 include (1) the initial correlation effort for man-machine model predictions of tracking performance with in-simulator and Dryden flight data (2) a study to determine kinesthetic cue effectiveness for integrated control/display studies in the TCV simulator (3) site preparation and cab assembly of an advanced concept simulator and (4) the continuing extension and application of improved interactive performance assessment techniques. Particular emphasis will be placed on mission simulation methodology, as a large scale terminal area simulation capability is being assembled locally for system studies needed to meet major objectives of the TCV program and the joint CDTI program. Application of such a large complex multi-man system requires resolution of many detailed technical issues which will be addressed under this program. Results of these efforts will be documented in NASA Technical Papers and Contractor Reports.

Multidisciplinary Research

W81-70061

505-36-11

Ames Research Center Moffett Field Calif

FUNDS FOR INDEPENDENT RESEARCH (AERONAUTICS)

G T Chapman 415-965-5654

(505-56-11)

It is planned to support innovative and discretionary basic research in areas related to aeronautics. The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA's requirements in aeronautics, including the technical fields of aerodynamics, fluid

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

mechanics flight mechanics power guidance and navigation applied mathematics propulsion and man-machine integration The OAST Research Council and the Ames Funds for Independent Research (FIR) Committee review unsolicited proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs Those research proposals that are judged by the Council and FIR Committee to be worthy of support on a scientific or engineering basis are selected as candidates for funding

W81-70062 505-36-12

Lewis Research Center Cleveland Ohio

FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)

Marvin E Goldstein 216-433-4000

The objective is to support innovative long range high risk basic research in areas related to aeronautics The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA's requirements in aeronautics including the technical fields of fluid mechanics materials noise pollution reduction combustion fuels and dynamic behavior and control Members of the Lewis Research Advisory Board at the request of the Chief Scientist review unsolicited research proposals that have been judged to be worthy on scientific or engineering grounds but have not been selected for support under the specific discipline programs because of the long range or high risk nature of the proposals or because of funding limitations in these other research programs Those research proposals that are judged by the Board to be worthy of support on a scientific or engineering basis are selected as candidates for funding These proposals are then prioritized by the Chief Scientist and funded to the extent permitted by available resources The Chairman of the OAST Research Council is kept informed of funding plans to prevent duplication and to provide coordination Progress and results are reported periodically by the Grant Monitor and submitted to the Chief Scientist for review and for distribution to OAST Research Council

W81-70063 505-36-13

Langley Research Center Hampton Va

FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)

W D Erickson 804-827-2471

The objective of this plan is to support basic research in universities in areas related to aeronautics through the funding of a limited number of unsolicited research proposals from various universities University research proposals that have been judged to be well worth supporting on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs are considered University research proposals that have been evaluated and are not funded through any of the research programs are reviewed by the Langley University Research Proposal Review Committee Those research proposals that are judged by this committee to be well worth supporting on a scientific or engineering basis are selected as candidates for funding through this plan The committee establishes a priority listing of these proposals and selects those efforts that are judged to be the more innovative and aimed at the longer term research of potential relevance to future NASA aeronautics programs

W81-70064 505-36-14

Hugh L Dryden Flight Research Center Edwards Calif

FUND FOR INDEPENDENT RESEARCH

E E Kordes 805-258-3311

This RTOP is to support innovative and discretionary basic research in areas related to flight of aeronautical vehicles The program pursues basic investigation of new technology in fundamental science and engineering needed to improve the performance and efficiency of aeronautical vehicles including the fields of applied mathematics and computer science materials structures aerodynamics and fluid mechanics propulsion systems control systems and flight dynamics The Chief Scientist (OAST) and the Research Council review unsolicited research proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other programs Those research

proposals that are judged by the council to be worthy of support are selected as candidates for funding

W81-70065

505-36-20

National Aeronautics and Space Administration Washington D C

CFD TRAINING PROGRAM

Ellis E Whiting 202-755-3280

The objective of the program is to produce highly trained people with advanced degrees in computational fluid dynamics (CFD) by developing a balanced graduate training program in CFD at a few selected universities A balanced program contains training in fluid physics aerodynamics computational methods and computer science

W81-70066

505-36-21

Ames Research Center Moffett Field Calif

AERONAUTICS GRADUATE RESEARCH PROGRAM - FY 1981

G Chapman 415-965-5654

The objective of this program is to develop the interest of student engineers in the field of aeronautical engineering provide on the job training in research methods and augment or enhance NASA's research programs The approach is to bring the Center's needs to the attention of the academic community Research topics are established by mutual agreement and the tasks are especially selected to not only be relevant to NASA's mission and of interest to the University faculty but to foster cooperative programs between the Government and Academia Cooperation may be evidenced by use of each others facilities and performance of the research at NASA installations The research conducted under this RTOP in FY 1981 will include aerodynamics acoustics flight mechanics and computational fluid dynamics It will be both theoretical and experimental in nature

W81-70067

505-36-22

Lewis Research Center Cleveland Ohio

GRADUATE RESEARCH PROGRAM IN AERONAUTICS

Marvin E Goldstein 216-433-4000

The objective of this RTOP is to sponsor graduate research and training in aeronautics which is relevant and acceptable to both NASA and the University Specific fields of research involve fluid mechanics engine inlet flow fans compressors fuels combustors mechanical components aeroacoustics materials engine dynamics and control computational fluid mechanics aeroelasticity and noise emissions

W81-70068

505-36-23

Langley Research Center Hampton Va

GRADUATE PROGRAM IN AERONAUTICS

W D Erickson 804-827-2471

This RTOP provides support for university graduate research in aeronautics in which there is a substantial involvement of graduate students at the Langley Research Center While formal classroom activities are conducted at a university campus a substantial portion of the graduate research activity is carried out at the Langley Research Center in conjunction with Langley staff and under the overall guidance of a faculty advisor The research pursued under this RTOP are in areas of aeronautics Research grants of cooperative agreements are awarded to a number of universities to pursue aeronautical research with support being mainly for graduate research students and to some extent faculty members associated with those students The selection of graduate research topics is determined by joint agreement between the university and NASA staff

W81-70069

505-36-24

Hugh L Dryden Flight Research Center Edwards Calif

UNIVERSITY RESEARCH IN FLIGHT TESTING TECHNIQUES

E E Kordes 805-258-3311

This RTOP supports university basic and applied research related to improving methods and techniques in flight testing of aeronautical vehicles The program is to promote the overall improvement in flight research through simultaneous advancement

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

in instrumentation testing methods equipment data recording and data analysis

General Aviation Research and Technology

W81-70070 505-41-11

Ames Research Center Moffett Field Calif

GENERAL AVIATION AERODYNAMIC PERFORMANCE TECHNOLOGY

R Hicks 415-965-6396
(505-31-31 505-31-41)

The objectives of this program are to provide an advanced technology base for the design of future aircraft that are safer more productive and clearly superior to foreign competition. The approach is to use analytical prediction methods wind tunnel measurements and flight test to develop techniques for optimizing airfoils and wing designs and to develop techniques for reducing aerodynamic drag associated with wing-body interference

W81-70071 505-41-13

Langley Research Center Hampton Va

GENERAL AVIATION AERODYNAMICS AND HANDLING QUALITIES TECHNOLOGY

A W Hall 804-827-3274

An advanced technology base will be developed to permit the design of general aviation aircraft that are safer more productive and clearly superior to foreign competition. This technology includes aerodynamic and propulsive performance stability and control and handling qualities. The work will be accomplished by computer analysis and techniques simulator studies and wind tunnel and flight tests of models and full scale aircraft. The work will involve tests and analysis for interference and design optimization drag reduction engine cooling drag improved airfoil design capability mission related stability control and handling qualities criteria improved stall/spin characteristics and improved flight test methods for measuring aircraft performance

W81-70072 505-41-18

Wallop Flight Center Wallop Island Va

GENERAL AVIATION AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS

W E Nelson 804-824-3411

The objective of this RTOP is to provide an advanced technology base for the design and operations of future general aviation aircraft that are safer and fuel efficient by pursuing analytical experimental and systems studies of general aviation piloting techniques air traffic control procedural concepts and aircraft flight dynamics. Specific research areas ultra-deep-stall descent VFR pilot performance in the terminal area heavy rain effects on aircraft performance and safety noise exposure simulation model and air traffic multi-glide slopes. Various data collection techniques are utilized to obtain data on aircraft flight dynamics and piloting procedures in the operating environment. These include single and multiple radar tracks in various environments pilot questionnaires photographic data and other techniques. Data are analyzed integrated into simulation models and simulations conducted to assess various design or operating alternatives

W81-70073 505-41-22

Lewis Research Center Cleveland Ohio

ADVANCED GENERAL AVIATION PROPULSION RESEARCH

E A Willis 216-433-6909

The objectives are to define the technology base for and promote the development of improved conventional spark ignition and the most promising alternative engine(s) for general aviation use in the late 1980s and on. The specific improvements and/or capabilities sought are multi-fuel lower BSFC weight cost and maintenance and improved reliability - while still meeting the 1979 emission requirements. Alternative engines are being

defined through studies and experimental engine tests supplemented by experimental investigations in key technology areas. The specific work in this program is supported by contracts grants and Lewis in-house studies and experimental programs

W81-70074

505-41-33

Langley Research Center Hampton Va

GENERAL AVIATION CRASH DYNAMICS

R G Thomson 804-827-3795

(505-33-53)

Both analytical and experimental methods will be used to develop and demonstrate new concepts in general aviation aircraft fuselage and interior design for improved vehicle crashworthiness. In-house full-scale and component testing of aircraft structures will be performed to determine the basic mechanisms involved in crash behavior and energy dissipation phenomena and will provide a means of defining pertinent crashworthiness parameters. In conjunction with the testing computer programs are being developed to simulate the gross fuselage behavior during crash impact and the dynamic response of localized structural components and seat and occupant behavior. Complimentary in-house and contractual studies will be employed to establish the best analytical modeling techniques for predicting accelerations loads and displacements of collapsing structure. The developed computer programs will be coupled with research on load limiting seat and subfloor concepts to design modified structural components with improved crashworthy characteristics. The new concepts will be demonstrated and evaluated by full-scale and component testing

W81-70075

505-41-43

Langley Research Center Hampton Va

GENERAL AVIATION PROPELLER NOISE REDUCTION

J P Raney 804-827-2645

(535-03-13 505-42-13 532-06-13)

The objective of this research is to provide data and a technology base for reducing general aviation propeller noise with minimum weight performance and economic penalties. Both analytical and experimental studies are involved and work will be accomplished both inhouse and by grants and contracts. The emphasis of the analytical effort is on the prediction of both propeller noise and the aerodynamic parameters which determine propeller noise. The emphasis of the experimental program is on evaluating noise prediction/reduction technology through model-scale tests with flight evaluation and demonstration of technology as required. Noise prediction is used both as a tool for developing noise reduction technology and to identify technology areas requiring further research

W81-70076

505-41-52

Lewis Research Center Cleveland Ohio

LOW-SPEED PROPELLER RESEARCH

D C Mikkelsen 216-433-6820

The objective of this program is to advance the technology of propellers for General Aviation aircraft to reduce energy consumption lower noise and improve aircraft safety. This program encompasses analytical and experimental work on propeller performance acoustics aeroelastic characteristics and low cost composites. Technology under this program will encompass a broad spectrum of propeller sizes power requirements and aircraft speeds applicable to current and future general aviation aircraft

W81-70077

505-41-63

Langley Research Center Hampton Va

GENERAL AVIATION AVIONICS AND CONTROL TECHNOLOGY

D R Downing 804-827-3209

(505-41-73 505-34-33 505-34-13)

The objective of this work is the development of advanced control display communication navigation guidance sensing and actuating concepts that will enhance the safety and utility of general aviation aircraft. The approach is to develop advanced avionics concepts and to evaluate their utility through simulation and flight studies. Both new concepts and those developed for CTOL and VTOL applications will be considered. Examples of research areas include (1) the use of advanced navigation control

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

and display systems to improve path tracking and reduce pilot workload during IFR terminal area operations (2) the use of data link systems to assist the pilot perform on-route and terminal area guidance and (3) the development of sensor and actuator concepts which provide new measurements or which replace expensive low reliable components Improved performance and increased capabilities without increased avionics cost are program goals

W81-70078 505-41-68

Wallop Flight Center Wallop Island Va

GENERAL AVIATION AVIONICS AND CONTROLS

W E Melson 804-824-3411

The aim of this RTOP is to develop and demonstrate advanced avionics and control systems feasibility of utilizing low cost digital systems technology for general aviation aircraft to improve performance safety operational capability and compatibility with air traffic control systems Specific research areas include automated pilot advisory system concept synthetic voice technology digital crash recorder feasibility assessment and digital in-flight IFR simulator development Studies of systems concepts systems definition engineering model development evaluation and demonstration of technology improvements will be used to achieve the technical goals

W81-70079 505-41-73

Langley Research Center Hampton Va

GENERAL AVIATION - SINGLE PILOT IFR SYSTEMS

J D Shaughnessy 804-827-3917

(505-41-63)

This effort will provide the background research and develop the technology required to improve the safety and utility of single pilot general aviation (GA) aircraft operating under instrument flight rules (IFR) Functional roles and requirements of the IFR pilot will be determined for current as well as future air traffic systems The pilot environment psychological state workload required actions and the interrelationship between these factors will be defined and characterized so pilot effectiveness can be maximized Aircraft and subsystem requirements will be assessed and design data and guidelines will be developed for systems that significantly aid the single pilot flying under IFR It will be determined if selected modifications to ATC procedures aids and pilot training might improve safety and utility of single pilot IFR operations Analyses simulation studies and flight tests will be performed on various cockpit display formats automatic and manual control systems advanced avionics systems flight data consoles microprocessor applications multi-mode displays flying qualities procedural and other software concepts speech synthesis and recognition capability advanced ATC concepts and advanced information and flight management systems

W81-70080 505-41-83

Langley Research Center Hampton Va

AERIAL APPLICATIONS AERODYNAMICS AND SYSTEMS INTERACTION

A W Hall 804-827-3274

The objective of aerial applications research is to improve the effectiveness and efficiency of agricultural production systems through application of aeronautical technology Specifically the technology will be developed for both short- and long-term improvements in the accuracy of distribution environmental health and safety aspects of aerial applications and improvements in aircraft aerodynamics flight controls structures and dispersal systems

Low-Speed Aircraft Research and Technology

W81-70081 505-42-11

Ames Research Center Moffett Field Calif

ROTORCRAFT AEROELASTICITY AND STRUCTURAL DYNAMICS

W Johnson 415-965-5043

(505-42-21)

The objective of this research is to improve the predictive capability for rotorcraft loads vibration aeroelastic stability and performance and where possible to develop rotors with improved dynamic characteristics This will be accomplished by developing and verifying analytical models for rotorcraft with particular emphasis on the structural dynamics and aeroelasticity It is important to note that the level of predictive capability required depends on the type of aircraft considered as well as on the technology level For some simple well-understood rotor systems satisfactory predictive capability may have already been achieved for new rotor systems and rotorcraft configurations additional work will always be required The accuracy of current and improved models of rotor dynamics will be assessed by comparison with experimental data As appropriate small scale and large scale wind tunnel tests will be conducted in order to define dynamics problems and verify and improve advanced analytical models

W81-70082 505-42-13

Langley Research Center Hampton Va

ROTORCRAFT STRUCTURES, VIBRATION, AEROELASTICITY, AND ACOUSTICS

W H Reed III 804-827-2265

(532-06-13)

The technology for the application of composite materials and design concepts in helicopter structures to improve performance and efficiency reduce costs and provide durability and energy absorption capability equivalent of metal structures will be developed through in-house and contractual studies Long-term durability of Kevlar secondary structures and graphite primary structures will be determined through flight service and structural testing studies Through analysis wind tunnel and flight studies effective means for reducing helicopter vibrations and evaluating aeroelastic characteristics of new rotor systems will be determined Active higher harmonic control of vibrations will be developed in wind tunnel studies and demonstrated in flight Analytical techniques for predicting coupled rotor/fuselage vibration levels will be developed and the application of structural optimization techniques to rotor blade design for minimizing vibrations will be evaluated Improved predictive methods for analysis of the unsteady airloads on rotors will be developed through in-house and contract studies Analytical and experimental studies will be made to identify significant factors contributing to the aerodynamic acoustic and aeroelastic characteristics of rotors Methods for predicting and reducing helicopter main and tail rotor noise will be developed and evaluated

W81-70083 505-42-21

Ames Research Center Moffett Field Calif

ROTORCRAFT AERODYNAMIC PERFORMANCE, DYNAMICS, AND HANDLING QUALITIES

W Johnson 415-965-5043

(532-03-11)

This RTOP covers research on all aspects of rotor aeromechanics (aerodynamics dynamic loads and stability performance and noise characteristics) and rotorcraft flight dynamics Flight dynamics research will be conducted to provide handling qualities and design criteria for specific missions The research will be conducted through analysis including math model improvement and development of advanced techniques of control system implementation ground based piloted simulation and flight research with the UH-1H (with V-STOLAND) and CH-47 The understanding and predictive capability of the aerodynamic and dynamic phenomena of advanced rotorcraft will be improved by conducting analytical small scale and full scale experimental

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Investigations of helicopter performance and noise rotor aerodynamics and wake characteristics drag and aerodynamic interference and rotor loads vibration and vibration reduction systems Specific advanced rotor configurations will be tested in the full-scale wind tunnel Theoretical and experimental research will be conducted to develop techniques to design rotors optimized for aerodynamic performance These techniques will include the effects of platform geometry airfoil section dynamic stall and wake-induced inflow Analytical models for the flow about rotorcraft fuselages including wake interaction will be developed

W81-70084

505-42-23

Langley Research Center Hampton Va

ROTORCRAFT AERODYNAMICS SCALE MODELING

J C Wilson 804-827-3611

(505-42-13)

The objective is to acquire experimental data both aerodynamic and acoustic regarding helicopter systems and components for correlation with analyses Using modeled helicopter systems and the Langley V/STOL wind tunnel experimental investigations will be conducted to acquire rotor performance data for advanced rotor configurations to measure rotor noise characteristics in particular blade slap for designed alleviation and to measure rotor wakes and wake effects for correlation with evolving computer codes

W81-70085

505-42-31

Ames Research Center Moffett Field Calif

INTEGRATED AVIONIC CONTROL SYSTEMS FOR ROTORCRAFT

G Meyer 415-965-5444

(505-34-31 512-54-11 505-42-21)

Advanced control technology will be developed to provide effective integration of airframe propulsion and subsystem control functions to enhance the performance economic viability and safety of future rotorcraft Studies of a total automatic flight control system (TAF COS) which uses a combination of open loop and closed loop controls will continue using the UH-1H helicopter In addition the TAF COS concept will be extended by applying it to the design of a flight control system for the tilt rotor aircraft and evaluating the performance of the resulting system A methodology for the system design and analysis will be developed This methodology will include the development of software and a distributed fault-tolerant network of microprocessors The necessary information/display concepts for adequate redundancy management will also be defined and developed Advanced concepts of redundant actuator systems will be studied and suitable redundancy management techniques developed with specific attention to system performance failure effects reliability and maintainability Advanced concepts of fault-tolerant data communication will be studied and a means for integrating the sensing computation display and actuator elements will be developed The resulting total fault-tolerant system will be evaluated in terms of safety cost reliability and maintainability using principally manned simulation and when necessary flight tests

W81-70086

505-42-51

Ames Research Center Moffett Field Calif

HEAVY-LIFT/SHORT-HAUL HYBRID AIRSHIP TECHNOLOGY

W H Deckert 415-965-6373

(530-02-11)

The objective of this RTOP is to provide aerodynamics flight dynamics control systems and structural dynamics technology development for promising modern hybrid airship concepts Emphasis will be on the flight dynamics simulation of a hybrid airship concept called the buoyant quad-rotor employing substantial amounts of rotor forces for lift and control and designed for transporting heavy payloads over short ranges In addition to the buoyant quad-rotor concept other heavy-lift/short-haul hybrid airship concepts will be studied including those with turbo-prop and ducted-fan propulsive-lift systems possibly in combination with rotor systems The program is currently concentrating on areas known to have the greatest uncertainties modeling and control of interconnected rotors aerodynamic interactions of rotors

and envelopes and gust and turbulence modeling Follow-on efforts will concentrate on effects of structural flexibility and control law development The work to be done includes analytical studies, computer simulation and wind tunnel testing

W81-70087

505-42-62

Lewis Research Center Cleveland Ohio

V/STOL PROPULSION RESEARCH

Carl C Ciepluch 216-433-6644

(532-05-12 532-05-11)

An efficient lightweight reliable lift/cruise propulsion system is a critical requirement for the successful design of V/STOL aircraft The technology base to provide the required system will be developed in selected critical areas which are unique to the V/STOL concept Analytical and experimental investigations will be conducted in the areas of fans inlets thrust deflector nozzles thrust control devices and ejectors operating in the hover and transition modes for both subsonic and supersonic propulsion system concepts

W81-70088

505-42-71

Ames Research Center Moffett Field Calif

ADVANCED V/STOL AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS RESEARCH

A Faye 415-965-6373

(505-31-41 532-05-11 530-02-11)

The objective of this RTOP which is a companion to RTOP 532-05-11 is to develop basic research and technology required to enable the development of military and civil aircraft having V/STOL capability and viable mission performance Theoretical and experimental generic research will be undertaken in the areas of high speed aerodynamics low speed aerodynamics and flight dynamics To insure that all major high speed propulsion system/airframe interactions are accounted for properly compact propulsion simulator technology will be developed for use in scale wind tunnel models of V/STOL configurations Methods for predicting high speed aerodynamic performance and forebody/inlet interactions will be refined Low speed wind tunnel aerodynamic research will concentrate on development of aerodynamic prediction techniques for both transition and ground effects improvement of experimental techniques and evaluation of methods for efficient control of V/STOL aircraft in hover Flight control system and display requirements will be investigated concurrently primarily through piloted simulation The flight control and display requirements obtained from simulation will be verified for all V/STOL flight phases when a suitable research aircraft becomes available

W81-70089

505-42-74

Hugh L Dryden Flight Research Center Edwards Calif

AV-8A V/STOL FLIGHT EXPERIMENTS

D H Gatlin 805-258-3311

(505-42-71 532-05-11)

The AV-8A program is directed at obtaining high quality aerodynamic performance and system models of the aircraft and also at improving flight test techniques for high diskloading V/STOL aircraft The results will be used to update simulating models for V/STOL flight dynamics research and to improve flight test and parameter identification techniques suitable for V/STOL-unique flight regimes First parameter identification and V/STOL modeling techniques will be studied to establish maneuvers and mathematical methods to be used during the flight test program An AV-8A or AV-8C model aircraft will then be instrumented and flown at Dryden A complete flying qualities investigation will accompany the parameter estimation tests so that existing handling qualities criteria and design guides may be validated as well

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

High-Speed Aircraft Research and Technology

W81-70090 505-43-11
 Ames Research Center Moffett Field Calif
FLIGHT VEHICLE DYNAMICS
 G N Malcolm 415-965-6266
 (505-31-41)

The objective of this research is to provide a basic understanding of the aerodynamic and flight dynamic characteristics of highly maneuverable aircraft through the development and utilization of improved wind tunnel measurement and analytic techniques including both static and dynamic methods. Ultimately through application of improved methods of testing and application of the test results including better simulations resulting from improved aerodynamic mathematical models new criteria can be established for designing vehicles capable of performing controlled maneuvers over an expanded angle of attack envelope. Investigations are in progress to evaluate various experimental methods for determining dynamic characteristics of aircraft and experimental capabilities are being upgraded for testing at high angles of attack and high Reynolds numbers both for static and dynamic characteristics. Dynamic apparatus are being investigated or constructed to evaluate aerodynamic coefficients which are pertinent to all phases of high maneuver flight from controlled motions to fully developed spins. Basic investigations are in progress to provide fundamental understanding of fuselage aerodynamics at high angles of attack.

W81-70091 505-43-13
 Langley Research Center Hampton Va
FLIGHT DYNAMICS
 J R Chambers 804-827-2184

The broad objective is to improve the stall/spin characteristics of high performance aircraft and to determine the effects of these characteristics in terms of piloting the aircraft. Specific objectives are (1) to investigate the fundamental nature of stall/spin including the development of test techniques and methods for theoretical analysis (2) to develop and evaluate the effectiveness of automatic spin prevention concepts (3) to determine static and dynamic aerodynamic characteristics of current and advanced configurations at high angles of attack and (4) to determine geometric characteristics which result in inherent spin resistance. The methods of approach include static and dynamic wind tunnel force tests, theoretical analysis, piloted simulator tests and dynamic model flight tests. Extensive participation in DOD airplane development programs is involved.

W81-70092 505-43-14
 Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT DYNAMICS AND HANDLING QUALITIES
 D T Berry 805-258-3311

The overall objective of this effort is to develop a better understanding of the phenomena, improved analytical and experimental techniques and new concepts related to dynamic and handling quality characteristics of aircraft in all flight regimes. Studies will be conducted to develop analytical techniques for determining stability and control derivatives from flight data to develop new techniques for evaluating handling qualities and for achieving desired aircraft responses and to develop improved aeroelastic aircraft analysis techniques. Analytical studies, computer algorithm development and programming and flight tests will be performed both inhouse and under contract and grants to meet these objectives. Improved techniques for estimating the unknown parameters of the math model and for improving the identifiability of the systems will be studied on flight test data. The stochastic control based on the estimates will then be tested in flight to assess the improvement of the system. Also the range of command responses of augmented vehicles that optimizes pilot-vehicle performance for a specific mission or task within a mission will be investigated. Emphasis will be on criteria for command responses that are meaningful to system designers.

W81-70093 505-43-21
 Ames Research Center Moffett Field Calif
HIGH PERFORMANCE AIRCRAFT AIRFRAME-PROPULSION INTEGRATION
 T J Gregory 415-965-5881
 (505-42-71 532-05-11)

The objective of this RTOP is to investigate airframe/propulsion system integration for advanced combat aircraft. Conceptual designs of such aircraft have incorporated a number of new features that potentially impact the integration of the airframe and propulsion system. Among these include the use of top mounted inlets with canards and strakes in close proximity to and in front of inlet system. One of the available VSTOL fighter configurations presently scheduled for wind tunnel testing will be modified to investigate the canard/strike/inlet interactions in more detail. This effort will be expanded to look at the influence of various forebody shapes on the inlet flow field and performance. In addition the model will be modified incorporating an ejector system into the flow metering section to provide inlet pumping to ensure accurate simulation at high angles-of-attack. Another area of concern that has arisen in developing some advanced configurations with the exhaust nozzles located near the center of gravity for either vertical or short take-off and landing operations is the effects of the exhaust plumes on the wave drag of the configuration. A research program with industry will be initiated to investigate these effects and correlate the results with available prediction methods.

W81-70094 505-43-22
 Lewis Research Center Cleveland Ohio
COMBAT VEHICLE AND MISSILE AERODYNAMICS AND FLIGHT DYNAMICS RESEARCH AND TECHNOLOGY
 David N Bowditch 216-433-6123
 (505-04-12)

The objective of this RTOP is to establish through analytical studies, system design efforts, model and full-scale test programs the technology base required for the application of unique configurations to future combat aircraft. The Lewis effort is focussed on propulsion system installation. Current activities are specifically directed toward providing the technology required for the design of nonaxisymmetric exhaust nozzles for turbine engines. The high maneuverability and STOL requirements anticipated in future aircraft designs lead to the application of nonaxisymmetric nozzles capable of thrust vectoring and reversing. Principle areas of concern will include cooling, heat transfer, structural design, weight and internal aerodynamics. The objectives will be accomplished through contract studies, nozzle design, fabrication and altitude testing. Particular emphasis will be placed on solutions to the complex cooling, structural and internal aerodynamic problems associated with nonaxisymmetric nozzles. Close coordination will be maintained with Langley Research Center, the Navy and the Air Force to assure that work in the propulsion area appropriately supports Air Force requirements and the aerodynamic work at Langley.

W81-70095 505-43-23
 Langley Research Center Hampton Va
COMBAT VEHICLE AND MISSILE AERODYNAMICS AND FLIGHT DYNAMICS
 C M Jackson 804-827-3134

The technical objective of this work is to develop the aerodynamic technology base for the design of future military aircraft and missile concepts. Analytical and experimental studies will be made to develop aircraft design rationale and evaluate advanced aerodynamic concepts such as supercritical aerodynamics, wing warp maneuver devices, thrust-induced lift, nonaxisymmetric nozzles and component interference. Similar studies will be made to extend the aerodynamic technology base for missile system including conventional cruciform stability and control concepts, airbreathing propulsion integration and monoplanar concepts. Studies will also be made to provide a technology base for evaluation of missile carriage and separation aerodynamics.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70096 **505-43-31**

Ames Research Center Moffett Field Calif

INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING

F W Steinle 415-965-5850

Technical assistance consultative services, and support through the use of NASA facilities will be provided to outside agencies and the aircraft industry. Principal assistance is to the Department of Defense (DOD) for aircraft and missile systems development programs. Joint activities will be conducted with other government agencies and industry. Industry support is generally provided on a fee basis. Areas of support include research activities to aid in assuring satisfactory aerodynamic and handling qualities of piloted aircraft in routine operational flight and in advanced weapon delivery tasks and in assuring satisfactory flight path and attitude control of these aircraft in given automatic flight modes (i.e. radar-guided approaches and landings on an aircraft carrier). Included are efforts to define and develop techniques for improvements of marginal or unsatisfactory characteristics of new airplane designs. Wind tunnels, flight simulators and central computer facilities (360 7600) together with applications of advanced control theory will be employed as required. FY-81 support is planned for the following specific systems: AV-8 F-18 Advanced Fighter Technology Integration Program (AFTI) Submersible Bodies Douglas ATMR Douglas AST Boeing 767 Boeing C-14 Advanced Missiles Damaged Missiles Advanced Aircraft and Grumman/Navy VTOL Aircraft

W81-70097 **505-43-33**

Langley Research Center Hampton Va

INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING

D V Maddalon 804-827-3838

The broad objective is to provide technical assistance and consultative services to outside agencies and aircraft industry programs which involve specific requests for NASA support. The principal assistance is to the Department of Defense for aircraft and missile development programs. Current activity is focused in the areas of stall/spin aerodynamic characteristics at subsonic transonic and supersonic speeds, flutter and aeroelasticity, structures, landing loads, simulation and propulsion system interactions on airframes and nozzles. The approach will involve tests in applicable Langley facilities consistent with the availability of test time and the utilization need for the particular facilities requested. Analysis of test results will be performed and selected results will be documented. Consultation will include participation in pretest conferences, technical evaluation boards and technical coordination and oversight committees.

W81-70098 **505-43-34**

Hugh L Dryden Flight Research Center Edwards Calif

INTERAGENCY ASSISTANCE AND TESTING

R G Bryant 805-258-3311

This RTOP is intended to cover interagency assistance using applicable Dryden flight test facilities. The broad objective is to provide technical assistance consultative services and test facility support to DOD for military programs and to industry which involve specific requests for NASA support. Recent activities of this kind include B-52 drop test for recertification of the F-111 crew escape system component improvement tests involving F-15, T-37, F-111 aircraft and support of the AFTI-16 (F-16) program. Some current activities include support of the Navy F-18 program and Firebrand Research Test Vehicle program. Analysis of test results will be performed and selected results will be documented. Consultation will include participation in pre-test conference, technical evaluation boards and technical coordination committees.

W81-70099 **505-43-44**

Hugh L Dryden Flight Research Center Edwards Calif

REMOTELY PILOTED RESEARCH AIRCRAFT TECHNOLOGY

W H Andrews 805-259-3311

This RTOP covers two areas: the RPRV Facility Development Program and the AD-1 Oblique Wing Research Airplane. The facility development task deals with the continued improvement

of the Remotely Piloted Research Vehicle Facility to support the flight testing of high performance and high risk vehicle concepts of the future. The facility development involves an on-going assessment of the software and hardware avionics interfaces between the respective test vehicles and the facility and equipment updating to meet additional and new requirements. The manned low speed jet Oblique Wing Airplane flight testing was initiated in December 1979 and to date twelve flights have been performed. During these flights the operational envelope has been expanded to an airspeed of 170 knots and a sweep angle of fifteen degrees. Due to uncertainties related to wing structural behavior at the higher sweep angles, flight envelope expansion is being accomplished for sweep angle changes of five degrees. To date the flying qualities appear as predicted with slight changes showing up in the comparison of the flight versus windtunnel predicted aerodynamic derivatives.

W81-70100

505-43-54

Hugh L Dryden Flight Research Center Edwards Calif

AIRCRAFT OPERATIONAL SUPPORT

B D Axley 805-258-3311

Equipment maintenance and operation are provided for (A) support aircraft including (2) F-104N (3) F-104G (1) T-38 (1) T-37 (1) C-47 and (B) Bell Helicopter and (B) service aircraft including B-52, PA-30 and JetStar. Major effort and coordination of activities is provided by inhouse resources with augmentation by supporting contractors (engine maintenance, AGE maintenance, inventory management) and reimbursable military elements (fuel parts, special functions). This effort supports research flight programs providing adequate proficiency of pilots, chase aircraft, R/D support in terms of research investigations and general operational support.

Transport Aircraft Research and Technology

W81-70101

505-44-12

Lewis Research Center Cleveland Ohio

AVIATION METEOROLOGY RESEARCH

R W Luidens 216-433-4000

The objective of this program is to update and advance the technology related to the safe and efficient operation of aircraft under atmospheric icing conditions. The program will be broad based encompassing both analytical and experimental research and conducted using in-house, contracted and university effort. It will be performed as a coordinated effort between the aircraft industry/users, Government agencies and the military. NASA will serve as the focal point for assembling a wide range of data and for dissemination of the data.

W81-70102

505-44-13

Langley Research Center Hampton Va

AVIATION METEOROLOGY RESEARCH-SEVERE STORMS RMS

A W Hall 804-827-3274
(505-44-23)

A technology base will be developed to improve the knowledge and understanding of atmospheric processes as they effect the design and safe and efficient operation of aircraft and aircraft systems. This will be accomplished by experimental and analytical programs aimed at providing an understanding of the predictability and the detectability and avoidance of hazards of severe storms to aircraft operations. These hazards include wind shear, turbulence, lightning, precipitation and icing. Protection against direct lightning strikes will be studied.

W81-70103

505-44-14

Hugh L Dryden Flight Research Center Edwards Calif

KNOWLEDGE OF HIGH ALTITUDE ATMOSPHERIC PROCESSES

T R Sisk 805-258-3311

The objective of this work is to improve the definition of atmospheric characteristics required for advanced aircraft design.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

and for more efficient safe aircraft operation. Phenomena which are emphasized include clear air turbulence, wind shear, temperature transients, pressure altimetry problems, and aircraft icing. Data on these phenomena are obtained from instrumented aircraft and are related to the meteorological conditions causing them by the use of mathematical models and climatological information. This work covers the study efforts both in-house and on contracts or grants as well as the development and acquisition of sensors needed to measure the atmospheric phenomena. Results of this work are applicable to aircraft system design, flight test activities and flight operations.

W81-70104 **505-44-15**
Jet Propulsion Laboratory Pasadena Calif
MICROWAVE TECHNOLOGY DEVELOPMENT FOR ATMOSPHERIC TURBULENCE STUDIES
B L Gary 213-354-3198

This RTOP is an outgrowth of the 1979 Clear Air Turbulence Flight Test Program. During these flights involving three experimenters, JPL demonstrated that passive microwave radiometers can measure altitude temperature profile for the altitude vicinity of the aircraft. It was further demonstrated that CAT (Clear Air Turbulence) is often associated with inversion layers. During FY-80 an improved microwave radiometer is being built for installation in NASA's C-141 (Kuiper Airborne Observatory). The objectives of this RTOP are to (1) obtain many flight hours of data with the new radiometer and begin to systematically explore the altitude relationship between CAT and inversion layers and (2) to investigate the possibility of using inversion layer lapse rate and inversion layer thickness for the prediction of maximum turbulence intensity. The approach is to employ statistical concepts to the relationships between the flight hours with turbulence at various severity levels the flight hours during which turbulence was and was not associated with flight within and close to inversion layers (and tropopause). Turbulence severity will be determined by measurements of the peak-to-peak excursion of the aircraft's vertical accelerometer during 5-second windows (with roll-related excursions not included).

W81-70105 **505-44-18**
Wallop Flight Center Wallop Island Va
AVIATION METEOROLOGY RESEARCH ATMOSPHERIC DYNAMICS AND MEASUREMENT TECHNOLOGY
Robert E Carr 804-824-3411
(505-08-28)

The objectives of this RTOP are to collect, analyze and model severe low-altitude wind shear, turbulence and storm outflow dynamics data as they apply to the safe and efficient operations of aircraft and aircraft systems, and to identify and test advanced sensors for automatic measurement of prevailing visibility, ceiling heights and wind shear. The comprehensive meteorological measuring systems existing at Wallop Flight Center (WFC) will be utilized to collect data associated with significant meteorological phenomena related to aircraft operating safety. Systems applicable to this research include two meteorological towers (250 ft and 300 ft) instrumented with two and three dimensional anemometers, and other sensors; precision wind profile balloons and radiosondes; precision video and doppler radars; LDAR, a fully equipped observation service and equipments; and instrumented test aircraft. Experiments will be configured to provide intense coordinated measurements during severe and/or significant meteorological events. Emphasis will be placed on low-altitude spatial changes as related to the specific aircraft operating problem during approach and departure flight phases and in identification of advanced meteorological sensor characteristics to meet current operational needs.

W81-70106 **505-44-19**
Marshall Space Flight Center Huntsville Ala
AVIATION METEOROLOGY RESEARCH - BASIC ATMOSPHERIC PROCESSES
Dennis W Camp 205-453-2087

Objectives are (1) to define, investigate and model those atmospheric conditions adverse to aircraft operations and possibly conductive to aircraft mishaps and (2) to conduct research relative to development of techniques, procedures and the need for new

and/or improved meteorological instrumentation whereby acquired knowledge of the natural environment can be better utilized for the safe operation of aeronautical systems. The approach will be to continue (1) to measure and analyze atmospheric data, (2) to develop models of atmospheric boundary layer properties and the conditions which lead to or intensify them, (3) to perform analytical laboratory and field tests relative to investigation of warm fog, and (4) to develop and/or modify instrumentation as needed to meet the requirements of this approach. To accomplish the objectives the following tasks will be performed: (1) correlation of lateral and longitudinal gusts and their effects on aeronautical systems and conduct of an aviation meteorology workshop; (2) atmospheric dynamics process definition as related to aeronautical system operations; (3) warm fog investigative studies relative to its dispersal; (4) investigation into buildup and dissipation of frost effects on aeronautical systems; (5) development of new or improved instrumentation for safer operation of aeronautical systems; and (6) atmospheric electricity as related to aeronautical systems.

W81-70107 **505-44-21**
Ames Research Center Moffett Field Calif
AVIATION SAFETY TECHNOLOGY - OPERATIONAL PROBLEMS AND FIREWORTHINESS
R L Kurkowski 415-965-6219
(505-33-31 534-05-11)

The objective of this RTOP is to improve aviation safety by increasing the understanding of the causes of accidents and by developing systems technology and piloting techniques for avoiding hazards. Research on post-accident analysis techniques is a cooperative program with the National Transportation Safety Board Bureau of Aviation Safety (NTSB-BAS). The objective is to develop improved techniques for analyzing accident recordings. Additionally, as part of a joint NASA/FAA program, simulator investigations will be conducted on the effectiveness of integrated head-up displays (HUD) on reducing hazards associated with wind shear and low visibility. Research will also be conducted in new technology to enhance the operational safety of IFR operations for civil and military rotorcraft and VTOL aircraft. The program on fireworthiness is oriented towards enhancing aircraft cabin safety in post-crash fires. The program includes (1) fuel anti-misting studies and the determination of fluid properties of modified jet fuel for inhibiting the ignition of fuel; (2) definition of post-crash fire threat scenarios; (3) development of laboratory flammability test methodology and combustion toxicology methods; (4) development of a cost/benefit survivability model for aircraft fire safety; (5) the evaluation of advanced aircraft interior materials which are fire-safe and provide advantages such as weight savings; and (6) evaluation of fire extinguishers.

W81-70108 **505-44-22**
Lewis Research Center Cleveland Ohio
AVIATION OPERATIONS SAFETY TECHNOLOGY
R Luidens 216-433-4376

The objective of this RTOP is to provide a broad base of safety oriented technology for identifying, defining and dealing with hazards associated with aeronautical propulsion systems and aircraft operation and establish criteria for systems design and operating techniques leading to reduction in accidents, loss of life and injuries, and loss of equipment. Research and technology activities that lead to solutions of problems impacting on aviation safety, with particular emphasis on propulsion systems, will be performed. Activity results will be coordinated with the FAA, NTSB, DOD, other interested Government agencies and the aviation community. Specific areas of current activities include hazards evaluation and safety assurance of liquid hydrogen and other fuels for use in aircraft fuel systems; crash fire prevention; engine condition monitoring; and systems safety analyses.

W81-70109 **505-44-23**
Langley Research Center Hampton Va
AVIATION SAFETY TECHNOLOGY--FLIGHT SAFETY
A W Hall 804-827-3274
(505-44-13)

A technology base will be developed which can be used to

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

reduce the number of aviation accidents and to minimize the fatalities and damage resulting from accidents. This will be accomplished by programs aimed at providing a data base for continued knowledge of the usage of various types of aircraft relative to their original design criteria. Research on equipment and systems will be undertaken relative to flight-path control and meteorological phenomena. Research will also be conducted to provide improved protection of the aircraft and its systems from hazards such as lightning, turbulence and wind shear.

W81-70110 **505-44-25**

Jet Propulsion Laboratory, Pasadena Calif

AVIATION SAFETY TECHNOLOGY - APPLIED FLUID MECHANICS

P F Massier 213-354-3549

The overall objective of this effort is directed toward improving aircraft fire safety. The studies include those aspects of safety associated with (1) the development of a detailed fire modeling methodology for the prediction of aircraft fire characteristics and the associated dynamic response of materials in an accidental fire environment, the analysis and prediction of the thermal characteristics of external pool fires resulting from post-crash fuel spills in order to characterize the fire hazards and the overall assessment of existing fire modeling capabilities for application to the post-crash aircraft fire scenario. The studies will also include (2) the determination of rheological and other fluid properties of modified antimisting jet fuel which are responsible for inhibiting the ignition of fuel during a survivable aircraft crash, the measurement of these properties so that the modified fuel can be quantified as to its antimisting behavior, filterability and ignitability characteristics.

W81-70111 **505-44-27**

Lyndon B Johnson Space Center Houston Tex

AIRCRAFT FIRE SAFETY AND TESTING

D E Supkis 713-483-3211
(534-05-17)

This RTOP consists of work originally started in FY-75 and continued through FY-80. The RTOP provides for development and testing new fire retardant non-metallic materials such as Electrical Wire Insulation Polymeric Molding Materials and Cargo Bay liners and the procurement of aircraft seats and components for testing functional size elements in the JSC 737 fuselage and the definition of toxicity testing techniques.

W81-70112 **505-44-28**

Wallop Flight Center Wallop Island Va

AVIATION OPERATIONS SAFETY TECHNOLOGY - WIND SHEAR AND COLLISION AVOIDANCE

Robert E Carr 804-824-3411
(505-44-18)

The objective of this RTOP is to demonstrate the feasibility of using existing air carrier weather radar and other aircraft systems to provide the pilot with an airspeed/ground speed comparison as an aid in flying through wind shear conditions on landing and take-off and to further use these systems for the automatic detection and collision alert of an impending mid air collision in the terminal area. State-of-the-art radar and microprocessor technology will be evaluated as a means of determining aircraft ground speed information through a combination of surface wind information up linked to the aircraft and vectorially added to the aircraft's airspeed. Proven Automated Pilot Advisory System (APAS) technology will be evaluated as a technique for providing an Airborne Automated Traffic Advisory System (AATAS) as an aid to the pilot in avoiding mid air collisions.

W81-70113 **505-44-29**

Marshall Space Flight Center Huntsville Ala

AVIATION OPERATIONS SAFETY TECHNOLOGY - APPLIED LASER TECHNOLOGY

E A Weaver 205-453-1597

Electro-Optic sensors using coherent light will be developed for application to aircraft operations and safety problems. In FY-81 a study will be made of the very wide variation of atmospheric aerosol density, the corresponding variation of the

backscatter coefficient in the 9 to 11 micrometer wavelengths and their effects on the performance requirements of CO2 electro-optic Doppler sensors that are applied to aircraft operations and safety problems. Remote measuring of atmospheric flow fields including Clear Air Turbulence (CAT) will use infrared coherent light electro-optic sensors. Other coherent light frequencies will be used as defined by systems analysis studies of several aviation safety problems. In-depth studies of specific problems will be made. A beta experiment flight test and its results along with system engineering studies will identify the research hardware design specifications for producing the required feasibility demonstration sensor systems. Proof of concept experiments will be conducted.

W81-70114 **505-44-31**

Ames Research Center Moffett Field Calif

AIRCRAFT SYSTEMS OPERATIONAL SAFETY AND EFFICIENCY IMPROVEMENT

M A Golub 415-965-5953

The objective is to improve aircraft safety and efficiency through the use of advanced materials in aircraft tires. This involves the development and evaluation of new tread and/or carcass formulations which will yield commercial and military transport aircraft tires having improved wear resistance, traction, blowout resistance and load-bearing characteristics compared to state-of-the-art tires based on natural rubber (NR) and cis polybutadiene (CB). Amorphous vinyl polybutadiene (VB) was found in laboratory track and flight tests to be a promising replacement for CB in tread stocks for Boeing 727 main landing gear tires. Since the VB rubber used to date (prepared by Ziegler-Natta polymerization) proved to be inconsistent in properties, new tread stocks will be compounded with NR and another VB (prepared by anionic polymerization) which is inherently capable of better uniformity and better properties than the Ziegler-Natta VB. Aircraft tires retreaded with the optimum NR/anionic VB formulation(s) will be evaluated in track and flight tests. Studies will be initiated on failure modes in aircraft tires and on risk assessment.

W81-70115 **505-44-32**

Lewis Research Center Cleveland Ohio

COMMERCIAL AIRCRAFT FUEL SAVINGS

R Steinberg 216-433-6677

The objective is to demonstrate through impact studies that near real-time high resolution flight level windfield and temperature data can provide the basis for increasing the accuracy of the airline flight plan (minimum fuel track profile) and that this improvement can result in substantial savings in fuel for the airline industry. To achieve this objective, comparisons will be made between flight plans developed from the present operational data base and those developed from enroute high resolution wind and temperature data. These results will then be evaluated against actual data provided by participating airlines. The minimum fuel track requirement for the flight plan provides unique criteria with which to translate the results of these comparisons directly into fuel savings for air carriers. The high resolution windfield and temperature data base required for this impact study has become available for the first time along several major airline routes as a result of an international meteorological experiment which began in December 1978 and was concluded in November 1979.

W81-70116 **505-44-33**

Langley Research Center Hampton Va

AIRCRAFT LANDING SYSTEMS EFFICIENCY IMPROVEMENTS

J L McCarty 804-827-2796

The specific objective is to examine new concepts and techniques which offer potential for reducing both operational complexities and costs of aircraft landing systems with a view toward use of the improved systems by large and small civil aircraft. Aircraft operations on prepared runways under adverse weather conditions and on certain unprepared surfaces present requirements of braking and steering systems, tires and the runway that are vital to aircraft safety and passenger comfort. The objectives of programs covered by this RTOP are (1) to improve the performance of braking systems (2) to improve

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

the wet traction and lifetime of pneumatic tires (3) to develop new landing gear systems that would permit operations on unprepared fields including water and permit continuous use of prime runways for all-weather operations (4) to evaluate tire cornering behavior with and without braking such that high-speed turnoffs can be designed to increase the flow of traffic at congested airports and (5) to relate the character of the runway surface to aircraft braking and steering performance. Research to meet these objectives will employ full-scale aircraft landing gear systems and subsystems, and scaled pneumatic tires. The landing loads track will be the primary test facility.

Aeronautics Systems Technology Programs

W81-70117 510-53-12
Lewis Research Center Cleveland Ohio
MATERIALS FOR ADVANCED TURBINE ENGINES (MATE)
Charles P Blankenship 216-433-6922
(505-33-12)

The MATE program is a cooperative Government-industry effort to help introduce new materials technologies into advanced aircraft turbine engines in order to more rapidly achieve potential economic and operational performance advantages. The general objective is to advance the development of selected materials technologies to help meet the needs of engines expected to be introduced into service in the 1980-90 time frame. The program is specifically aimed at accelerating the transfer of at least ten materials technologies from the laboratory-feasibility stage to engine-demonstration testing. This will be done through scale-up of selected materials technologies to allow the reliable manufacture and rig testing of engine components and the subsequent verification of their potential performance improvements in ground based engine tests. Cost/benefit and risk analyses are conducted to help guide the selection of the best candidate materials. The program is conducted through contracts with the domestic aircraft turbine engine industry.

Materials and Structures Systems Technology

W81-70118 510-54-13
Langley Research Center Hampton Va
INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN (IPAD)
R E Fulton 804-827-2887
(505-33-63)

The objectives of this RTOP are to reduce vehicle design cycle time and design costs in the 1980's through development of components of a computer software system denoted IPAD for the total management of aerospace-vehicle design processes. System design and prototype software will demonstrate a 25% reduction in flow time for vehicle preliminary design tasks, a 50% reduction in man-hours to assemble engineering data for component design and a 25% reduction in time and cost to generate engineering drawing data. The Industry Technical Advisory Board (ITAB) will review and critique development work and will be provided software components for evaluation and use as they are developed. Continued coordination will be maintained with the Air Force Integrated Computer Aided Manufacturing (ICAM) program to maximize benefits from the two programs.

W81-70119 510-55-12
Lewis Research Center, Cleveland Ohio
AEROELASTICITY OF TURBINE ENGINES
C L Ball 216-433-6835
(505-32-52 505-32-22 505-33-52)

The aeroelastic program is directed towards improving flutter boundary design criteria so that the occurrence of flutter in fans and compressors for advanced propulsion systems is essentially

avoided. If flutter is encountered these criteria may also be used to expeditiously clear flutter from the operating region. The program will also provide through analytical and experimental research a more fundamental basis for reliable analysis prediction and thus the avoidance of instability regions. Analytical methods and computer codes will be developed to predict the unsteady aerodynamic forces under various flutter conditions and to calculate the structural modes of blades, shrouds and disks as utilized in fans and compressors for advanced engines. The unsteady aerodynamic analysis will be verified in cascades in which the blades are driven as if they are in flutter. The structural analysis will be verified in a vacuum spin rig and vibration rigs. The coupling of the aerodynamic forces and structure will be verified in suitable instrumented experimental fans. The prediction method will be further verified by application to realistic data such as that obtained in full-scale engine research programs. This aeroelastic program is the NASA portion of an interdependent and coordinated program involving LeRC and AFAPL. The effort involves inhouse projects as well as contract research with aerospace companies and grants to various universities.

W81-70120 510-57-12
Lewis Research Center Cleveland Ohio
TURBINE ENGINE HOT SECTION TECHNOLOGY (HOST)
M H Hirschberg 216-433-4000
(505-33-22)

The HOST program will develop the analytical tools needed for improving the prediction of the durability of combustor liners and turbine vanes and blades of advanced aircraft turbines. It will demonstrate that these models and predictive tools describe the complex environment and loading conditions to which these components are subjected more accurately than is currently possible.

Propulsion Systems Technology

W81-70121 511-55-12
Lewis Research Center Cleveland Ohio
ADVANCED LOW EMISSION COMBUSTOR (ALEC)
D A Petrush 216-433-6860
(505-32-32 505-32-72)

The objective is to evolve lean premixed prevaporized combustion technology into a practical aircraft gas turbine engine combustion system that exhibits superior performance, high durability, fuel flexibility and environmentally acceptable pollutant emissions over the entire flight envelope. Oxides of nitrogen emissions will be reduced by operating the combustion system at extremely lean fuel-air mixtures. Initially, fundamental in-house, grant and contract studies examined practical problems associated with this technique and combustor constraints imposed by the engine. With the design information from the initial studies, combustor concepts are being integrated into engine system designs for assessment. Concepts which show potential for achieving program goals will be tested and screened. The most promising designs will be refined through component tests possibly leading to an engine verification.

W81-70122 511-58-12
Lewis Research Center Cleveland Ohio
HELICOPTER TRANSMISSION TECHNOLOGY
E V Zaretsky 216-433-6101
(505-32-42 506-53-12)

The objectives of this work are (1) to demonstrate improvements in weight, noise, reliability, maintenance cost and size of helicopter transmissions, (2) to demonstrate compactness, reduced noise and reliability characteristics of hybrid traction drive systems and (3) to demonstrate transmission life increase of 200 percent with conventional drive systems through the application of advanced technology power transfer components.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70123

511-59-12

Lewis Research Center Cleveland Ohio

BROAD PROPERTY FUELS TECHNOLOGY

J Grobman 216-433-6229

(505-03-22 511-55-02 505-32-72)

The objectives of this effort are to evolve and demonstrate the combustor technology required to utilize broad property fuels in current and next generation commercial jet aircraft. The intention of this project is to extend the current R and T base Fuels Research Program being performed through RTOP 505-32-72 to an integrated component investigation resulting in engine verification tests of fuel flexible advanced combustors. The engines selected are advanced high-bypass ratio turbofan designs. The effort is being conducted through multi-phase contracts using two parallel contractors Pratt and Whitney and General Electric throughout the length of the project. The technical conduct of this project effort will be similar to the multi-phase approach used in the NASA Experimental Clean Combustor Program. The multi-phase contract effort will consist of three consecutive phases which will systematically screen out the more promising combustor and associated fuel system concepts for using broad property fuels (Phase I) evolve these concepts into component hardware which is compatible with an existing engine (Phase II) and perform actual verification tests to document engine performance and durability (Phase III).

Avionics and Flight Controls Systems Technology

W81-70124

512-54-11

Ames Research Center Moffett Field Calif

ADVANCED GUIDANCE AND CONTROL SYSTEMS VALIDATION TECHNOLOGY

H C Lessing 415-965-5567

(532-06-11 505-34-43)

The objectives of this joint NASA/FAA program are to improve the Government's understanding of digital flight control system (DFCS) verification and validation (V and V) technology and to evaluate and improve DFCS V and V tools and techniques. The approach involves the development, adaptation, evaluation and improvement of present and promising state-of-the-art redundant DFCS verification and validation tools and techniques utilizing a representative near-term Redundant DFCS (RDFCS) facility to support this effort. Automatic software verification tools plus hardware verification and system validation tools/techniques are included. A series of workshops will be held to keep the FAA abreast of this technology and to summarize the results of each major program element to industry and Government.

W81-70125

512-54-14

Hugh L Dryden Flight Research Center Edwards Calif

ADVANCED GUIDANCE AND CONTROL FLIGHT SYSTEMS EXPERIMENTS

C R Jarvis 805-258-3311

(505-34-34)

The overall objective of this effort is to provide the technology necessary for the implementation of advanced reliable digital flight control systems in future aircraft. The program involves the development and demonstration of a unique flight test facility and its use in carrying out experiments to exploit state-of-the-art advancements in digital technology. The facility allows flight test evaluation in an operational environment of unique advanced control law concepts, failure management techniques and operational procedures. Present activity is directed toward evaluation of innovative failure management techniques which take advantage of the increased computational capability of digital systems in achieving a higher degree of system reliability and integrity.

Aeronautical Systems Studies

W81-70126

530-01-13

Langley Research Center Hampton Va

GENERAL AVIATION SYSTEM TECHNOLOGY STUDIES

R J Tapscott 804-827-3216

The objective of this work is to undertake studies to evaluate missions and aircraft design concepts in order to identify the technology requirements for increased performance, productivity and safety of general aviation aircraft. These studies will identify the design and operational systems requirements, and attendant costs and benefits for existing as well as for future general aviation aircraft missions.

W81-70127

530-02-11

Ames Research Center Moffett Field Calif

LOW SPEED AIRCRAFT SYSTEMS STUDIES

J Zuk 415-965-6569

(505-42-71 532-05-11 530-02-18 505-42-51 532-06-11)

The general objectives of this RTOP are (1) to assess rotorcraft (including Hybrid Airship (HA) and V/STOL aircraft) mission requirements, growth patterns, markets, foreign competition, productivity criteria and national needs/benefits of importance in the definition of integrated agency programs (2) to assess technology that will substantially improve operational suitability of existing or derivative conventional rotorcraft in the areas of vibration, noise, safety, costs, etc. and (3) to assess advanced vehicle configuration concepts in rotorcraft and V/STOL aircraft which offer performance and operational advantages for civil and military applications. The results of these studies will provide data and identify promising research options for incorporation into long-range NASA low speed aircraft program planning.

W81-70128

530-02-18

Wallop Flight Center Wallop Island Va

AIRBORNE EXPERIMENT PLATFORMS

H C Needleman 804-824-3411

This study effort is directed toward establishing the utility and technology requirements of two classes of unmanned airborne experiment platforms - high altitude powered platforms including heavier-than-air and lighter-than-air vehicles and unpowered platforms including tethered and mid-air-deployed balloon-borne platforms - for use by the scientific and applications experimenter community as tools to complement existing research techniques. User applications, mission concepts and system concepts will be investigated with emphasis on high altitude and deployment operations, compatibility with science user requirements and system integration.

W81-70129

530-04-12

Lewis Research Center Cleveland Ohio

PROPULSION SYSTEMS FOR SMALL TRANSPORTS

R J Weber 216-433-4000

This RTOP covers the propulsion efforts at Lewis in support of the Small Transport Advanced Technology (STAT) program led by the Ames Research Center. Studies are performed to identify engine and propeller designs suitable for commuter aircraft. Selected component research is subsequently carried out to advance the various technologies that are found to be most beneficial.

W81-70130

530-04-13

Langley Research Center Hampton Va

LONG HAUL TRANSPORT AIRCRAFT SYSTEMS STUDIES

C Driver 804-827-3216

The objective will be to provide technology for advanced transport aircraft and aircraft systems through studies and evaluations of (1) all-new total aircraft configurations and concepts, (2) promising new subsystem concepts in advanced aircraft configurations, (3) semi-developed technologies for aircraft applications and opportunities, (4) transportation system interactions with avionics other subsystems and aircraft, (5) operational aspects of aircraft systems in areas significant to advanced technology and (6) market demands and economics as impacting needs for aircraft. These studies covering future needs for both

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

passenger and cargo transports are aimed at improving aircraft economics fuel use noise emissions airport congestion and traveler acceptance and providing an information base for technology program planning in support of improved near-term and future long-haul air transportation systems for civil and military purposes Both in-house and contractual efforts will be utilized

W81-70131 530-05-12

Lewis Research Center Cleveland Ohio

ADVANCED PROPULSION SYSTEM CONCEPTS

R J Weber 216-433-4000

Studies will be performed of engine cycles complete propulsion systems and integrated engine/airframe combinations applied to representative airplane missions The object of the studies is to determine desirable engine component and system design characteristics for future aircraft and to identify technology deficiencies and profitable areas for research The studies will explore the opportunities for satisfying environmental and natural resource constraints and their related impact on propulsion system selection and aircraft performance

General Aviation Systems Technology

W81-70132 531-01-11

Ames Research Center Moffett Field Calif

GENERAL AVIATION ADVANCED AVIONICS SYSTEMS

D G Denery 415-965-5438

(531-01-12 532-01-11)

The objective of this program is the design and demonstration of a totally integrated advanced low cost avionics system to enhance the safety reliability and utility of future general aviation aircraft The approach is to synthesize various subsystem concepts and conduct supporting studies of the projected microelectronic and fluidic technology aircraft design and air traffic control environment of the 1980's to formulate a system definition which can be scrutinized against requirements and cost-benefit criteria to formulate final specifications and designs The system design will be verified in simulations and flight tests with active participation of the FAA and the aviation industry This is a joint program between Ames Research Center (ARC) and Langley Research Center (LaRC) The lead center is ARC who in addition to subsystems development is responsible for the overall final system design fabrication simulations and flight tests LaRC is responsible for the development of fluidic and other avionic subsystems with emphasis directed towards the light aircraft end of the general aviation spectrum

Low-Speed Systems Technology

W81-70133 532-01-11

Ames Research Center Moffett Field Calif

ROTORCRAFT OPERATING SYSTEMS TECHNOLOGY

G Xenakis 415-965-5430

(505-34-11 532-05-11)

The objective of this research is to provide the critical technology to allow rotorcraft operating under instrument meteorological conditions (IMC) to have operating performance comparable to performance under visual meteorological conditions (VMC) By accomplishing this objective it is expected that system safety will be improved and productivity increased The research program will be based on needs requirements and operating experience of the users in coordination with the FAA and industry Systems concepts will be defined constructed and evaluated through simulations controlled flight research under highly instrumented conditions and operational flight assessments There are three main all-weather rotorcraft system technology thrusts These are (1) remote sites on-board systems technology (2) navigation and guidance concepts and operating systems research for operations into high density terminal areas and integrated category 3 systems and (3) investigations of XV-15 advanced rotorcraft operating systems On-board systems

technology will be developed and validated for IMC approach guidance and navigation to off-shore and on-shore remote sites Guidance and navigation concepts and operational procedures will be investigated that allow use of airspace separate from that used by conventional takeoff and landing (CTOL) traffic Emphasis will be on the exploration and development of concepts that will allow rotorcraft to operate IFR with the same utility and flexibility that they currently have under VFR

W81-70134 532-02-11

Ames Research Center Moffett Field Calif

QUIET PROPULSIVE-LIFT TECHNOLOGY EXPERIMENTS - AIRCRAFT PERFORMANCE AND OPERATING SYSTEMS RESEARCH

J Cochrane 415-965-5662

This program will furnish the US Government and aircraft industry with flight data to develop certification criteria and design methods for civil propulsive-lift short-haul transports It will take maximum advantage of civil-military STOL/RTOL transport commonality The program will develop advanced technology for propulsive-lift short-haul transport applications which will benefit civil derivatives of future-generation military STOL transports and future civil propulsive lift R/STOL transports Broad flight experiment areas involve (1) correlation of methods for predicting vehicle characteristics with flight-measured characteristics (2) studies of certification criteria for quiet propulsive-lift transport (QPLT) and (3) studies of flight control systems cockpit displays and navigation system requirements for STOL/RTOL terminal area flight operations These experiments will be conducted through a flight test program using the quiet short-haul research aircraft (QSRA) A small part of the QPLT effort includes ground-based technological efforts to support and/or compliment flight activities Most of the flight experiments will be conducted on the QSRA with the approach being to utilize the QSRA as a national propulsive-lift flight facility

W81-70135 532-02-12

Lewis Research Center Cleveland Ohio

QPLT SYSTEMS TECHNOLOGY

M F Valerino 216-433-6604

This RTOP provides for Lewis Research Center participation in the NASA Quiet Propulsive Lift Technology (QPLT) Experiments Program which includes flight research experiments in the areas of propulsion system performance and noise to be conducted using the NASA Quiet-Short-Haul Research Aircraft (QSRA) Emphasis will be on propulsion acoustics including measurements of the engine installation effects the fan-inlet treatment suppression characteristics and the effects of forward velocity on the farfield noise characteristics Also consideration will be given to obtaining in-flight air turbulence data for correlation with fan-inlet noise generation The flight measurements will be made through a cooperative effort with Ames Research Center In addition continuing QSRA propulsion support will be provided

W81-70136 532-03-11

Ames Research Center Moffett Field Calif

ADVANCED ROTOR SYSTEMS TECHNOLOGY/RSRA OPERATIONS

H K Edenborough 415-965-6567

(505-42-21 530-02-01 532-06-11)

The objective of this systems technology program is to provide and validate integrated rotor system technology required to substantially improve the performance utility efficiency dynamics noise maintainability and ownership cost of civil and military helicopters through system design studies focused small and large scale tests in ground-based facilities and selected flight tests of current state-of-the-art rotors and advanced concept rotor systems The goals of this program are to (1) advance the aerodynamics and structural dynamics technology of rotor blades to increase performance and efficiency and to reduce noise vibration weight cost and control system requirements (2) improve rotorcraft gust response and flight stability and control characteristics through utilization of active rotor control and composite construction technologies (3) expand the ground-based facility data base on rotors of opportunity and on a family of new blades having systematic variations in aerodynamic design

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

parameters (4) expand the flight data base on existing rotors that can be readily adapted for evaluation on RSRA (and other test rotorcraft) and (5) expand the design criteria for rotor and rotor control systems to improve rotorcraft handling qualities through high fidelity moving-base simulations

W81-70137

532-04-11

Ames Research Center Moffett Field Calif

TIKT ROTOR RESEARCH AIRCRAFT FLIGHT INVESTIGA- TIONS

D D Few 415-965-6445

For several years NASA and the Army have been engaged in a joint effort to advance the technology of tilt rotor V/STOL aircraft. The significant ongoing effort is the NASA/Army XV-15 Tilt Rotor Research Aircraft (TRRA) Project. The project aircraft development and Airworthiness Flight Testing were completed in 1979. The Flight Investigation Program POC flight tests to be completed in 1981 will satisfy the objectives of the project namely verify rotor/pylon/wing dynamic stability and performance establish a safe operating envelope assess handling qualities investigate gust sensitivity and investigate the effect of disk loading and tip speed on downwash and noise in hover mode. The goal of this Flight Investigation Program is to provide the U.S. aircraft community the design criteria and operational data required for the development certification and operation of Tilt Rotor V/STOL Aircraft with low technical risk. This will be accomplished by conducting high risk proof-of-concept testing at Dryden and then conducting flight tests of military and civil mission profiles near terminal operations and detailed handling qualities evaluations at Ames or nearby government facilities. Also at Ames flight experiments involving automatic landing and guidance and navigation will be conducted. Studies will be conducted in areas where new technology holds promise for significant payoff when applied to tilt rotor aircraft. Correction of minor aircraft deficiencies will be accomplished at Ames.

W81-70138

532-04-14

Hugh L Dryden Flight Research Center Edwards Calif

FLIGHT TEST OF THE TILT ROTOR RESEARCH AIR- CRAFT

W D Painter 805-258-3311

This RTOP covers Dryden Flight Research Center (DFRC) support to Ames Research Center (ARC) for the flight test of the Tilt Rotor Research Aircraft (TRRA) program. DFRC will support a joint flight-test team with Flight Operations and Support and Engineering directorates as needed to successfully complete the flight-test program. This plan covers the conduct of all proof-of-concept flight testing of the XV-15 Tilt Rotor Research Aircraft at DFRC considering the overall technical objectives manpower funding and program schedules.

W81-70139

532-05-11

Ames Research Center Moffett Field Calif

V/STOL SYSTEMS TECHNOLOGY

A Faye 415-965-6373

(505-10-31 505-06-51 505-06-61 791-40-21)

The objective of this RTOP which is a companion to RTOP 505-42-71 is to provide the systems technology required to enable the development of military and civil aircraft having V/STOL capability and viable mission performance. Theoretical and experimental configuration-dependent technology development will be undertaken in the areas of high-speed aerodynamics, low-speed aerodynamics and flight dynamics. Critical areas of aerodynamic uncertainty are being identified to guide future research efforts. To insure that all major high-speed propulsion system/airframe interactions are accounted for properly, compact propulsion simulators will be incorporated into the high-speed scale-model experimental investigations of potential V/STOL configurations. Low-speed aerodynamics research will concentrate on the aerodynamic characteristics of high performance powered-lift configurations, development of high performance augmentors for V/STOL application and providing design criteria for the development of V/STOL nacelles. Flight control system and display requirements will be investigated for specific configurations primarily through piloted simulation. Studies will

be conducted to define designs and cost estimates for several V/STOL research aircraft concepts.

W81-70140

532-05-12

Lewis Research Center Cleveland Ohio

V/STOL PROPULSION SYSTEM TECHNOLOGY

Carl C Ciepluch 216-433-6644

(505-42-62 532-05-11)

The development of viable military and civil aircraft having vertical-takeoff-and-landing (VTOL) capability in addition to performance capabilities approaching those of current operational aircraft (CTOL) requires the development of additional propulsion system technology. Two propulsion industry contractors have been selected to develop math models and control logic for advanced supersonic V/STOL propulsion systems. These efforts will lead to future piloted simulations at NASA Ames. System architecture studies will be conducted by competitively selected teams consisting of aircraft propulsion and digital system companies. Key technology programs will also be undertaken by NASA to support V/STOL propulsion development using funds provided by the Navy. The programs will be outlined in the joint Navy/NASA document formalizing the work. The program could include aerodynamic testing of fans, inlets, thrust deflectors, ejectors and thrust control devices.

W81-70141

532-06-12

Lewis Research Center Cleveland Ohio

ADVANCED ROTORCRAFT PROPULSION TECHNOLOGY

Carl C Ciepluch 216-433-6644

(505-42-21 505-42-31 530-02-11 505-44-12 511-58-12)

One part of the NASA Advanced Rotorcraft Technology Program is concerned with developing propulsion technology. This effort includes work in the areas of engine components, transmissions and propulsion system integration. The objectives of this program are to improve propulsion system durability, reliability and cruise fuel consumption to reduce life cycle costs to develop propulsion technology unique to high productivity vehicles and to increase operational capability and flexibility. The engine component program will include work in compressors, combustors, turbines, controls, icing and diagnostics. These efforts will include developing design methods and confirming them in experimental component tests. Advanced concepts will also be experimentally evaluated. The transmission program will involve developing design methods for advanced transmission components, experimentally verifying these design methods and performing selected flight test evaluations. The system integration effort will include evaluating advanced components in an engine system and the integration of a number of advanced technologies into an experimental engine for evaluation and demonstration of technology readiness.

W81-70142

532-06-13

Langley Research Center Hampton Va

ADVANCED ROTORCRAFT SYSTEMS TECHNOLOGY- MATERIALS AND NOISE

H B Dexter 804-827-2869

(505-42-13)

The objectives of this research are to develop advanced composites technology for low-risk primary helicopter airframe designs that provide increased vehicle efficiency and productivity through reduced fuel consumption and life-cycle costs along with increased payload and mission capability. To develop the technology for reducing the interior noise of helicopters through transmission/mainframe isolation and to develop the technology for improving rotor noise prediction methodology through the acquisition of model scale performance pressure loading and acoustic data. NASA will participate with the U.S. Army in a cooperative effort to develop composites with major emphasis on aggressive design and fabrication concepts beyond the current state-of-the-art technology. Contract studies will be performed of rotorcraft interior noise with emphasis on quantifying the noise radiated by the transmission and attenuating this noise by means of isolator systems. In the noise prediction area, model scale performance pressure loading and acoustic data will be acquired in the Langley V/STOL tunnel for the purpose of developing and validating first principles noise prediction methods to guide

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

a Langley/Ames cooperative flight experiment using the RSRA and to validate wind-tunnel technology for use in determining the performance and noise characteristics of new rotorcraft

High-Speed Systems Technology

W81-70143 **533-01-11**

Ames Research Center Moffett Field Calif

FUEL TANK SEALANTS

R W Rosser 415-965-5244

Fuel tanks sealants will be developed which offer improved service life under conditions encountered in advanced supersonic aircraft when compared to state-of-the-art materials. The specific objective is to obtain pilot plant quantities of characterized and useful sealant materials for flight test evaluation. The goal will be accomplished through a series of steps as follows: Produce a fluoroether prepolymer in the 20 lb range; convert it to a gum stock containing an appropriate cross-linking; formulate the sealant elastomer into a material suited to a fillet seal application; and apply the fluoroether sealant to flight simulation studies and develop a performance specification from actual flight tests. Finally the technology base will be increased by utilizing new fluoroether materials to modify polymeric systems such as composite resins and adhesives for expanded applications.

W81-70144 **533-01-13**

Langley Research Center Hampton Va

SCR-MATERIALS AND STRUCTURES

T T Bales 804-827-4581

(505-33-63 505-33-73 505-33-13 505-33-23 505-33-33 505-33-53)

The objective is to establish a supersonic materials and structures technology base by developing capability in structural concepts and design loads aeroelasticity and materials fatigue and manufacturing methods. The development of capability for computer-aided analysis and synthesis will be undertaken and validation of the computer design tools and methodology by applications to supersonic cruise configurations will be made. Advanced transonic/supersonic aeroelastic load prediction methods will be developed and a description of high altitude atmospheric turbulence environment obtained. Included also is work on strength, fatigue and fracture and damage-tolerance to establish structural integrity of materials and representative components. Application of advanced resins and adhesives and performance of time-temperature-stress studies of composites and development of fabrication methods for composites and titanium with emphasis on superplastic forming. The technology from this program will permit major reductions in structural weight, improved structural integrity and lower cost for supersonic cruise aircraft.

W81-70145 **533-01-14**

Hugh L Dryden Flight Research Center Edwards Calif

SCR MATERIALS AND STRUCTURES FLIGHT RESEARCH

Berwin M Kock 805-258-3311

The objective of this activity is to advance the technology related to structures and materials suitable for high speed cruise and/or high temperature applications. Airframe component parts will be manufactured, laboratory tested and installed on airplanes for flight validation. Components will be manufactured of both metallic and composite materials. Flight tests will be conducted to validate laboratory and analytical results. In flight measurements will be obtained on a structural mode control system at supersonic speeds. These measurements will be obtained on a B-1 airplane.

W81-70146 **533-01-32**

Lewis Research Center Cleveland Ohio

SCR PROPULSION TECHNOLOGY

R J Weber 216-433-4000

Advances in propulsion system technology will be required to permit the development of a quiet, clean, economical commercial supersonic transport. Contracts for the study of such airplanes have been let by Langley Research Center and other

supporting work is being performed at each of the NASA Research Centers. As part of that effort, LeRC is studying the propulsion system in order to define the most desirable engine cycle, identify technology requirements and advance the various component disciplines peculiar to supersonic flight to the point where design of an experimental engine (VCEE) could be undertaken when desired. The effort involves in-house and contracted research in engine cycles, noise and pollution, stability and control materials and various unique components.

W81-70147 **533-01-43**

Langley Research Center Hampton Va

SCR - AERODYNAMIC PERFORMANCE TECHNOLOGY

C Driver 804-827-3216

The objectives of this program are to advance the state of the art in supersonic aerodynamics through the generation of comprehensive data bases on promising advanced supersonic configuration concepts and through the development of better tools for aerodynamic design and analysis. Aerodynamic advances resulting from this program will be studied in concert with technology advances in the related disciplinary areas of propulsion structures and materials and controls through detailed technology integration studies of representative supersonic cruise aircraft concepts. Throughout the studies major consideration will be given to the factors which influence and improve the noise, sonic boom, energy efficiency and overall performance of potential future supersonic cruise aircraft. Objectives of the program will be accomplished through support of in-house, industry and university approaches to the development of new design and analysis methods and through wind tunnel tests of both industry and NASA designed supersonic cruise configurations. In-house and industry technology integration teams will assess the applicability and potential payoff of advanced supersonic technology to an adequate depth so as to provide reliable direction to future research efforts.

W81-70148 **533-01-62**

Lewis Research Center Cleveland Ohio

PROPELLION SYSTEM/AIRFRAME INTEGRATION TECHNOLOGY

D N Bowditch 216-433-6123

Present inlet concepts in inlet-engine-airframe integration methods will be evaluated and the generation of advanced concepts and methods will be initiated. Inlet and inlet control analysis-design methods will be assembled and evaluated. Existing subscale inlet hardware (as is or modified) will be tested to verify analysis methods and to provide a data base for areas such as low speed aeroacoustics and high speed off-design and angle of attack performance. These studies and tests will be conducted both in-house and on contract to supersonic cruise research and variable cycle engine contractors. This effort is a precursor to the 1983 Nacelle/Airframe Integration new start.

W81-70149 **533-01-63**

Langley Research Center Hampton Va

SCR - AIRFRAME/PROPULSION SYSTEM INTERACTIONS

C Driver 804-827-3216

Model variable cycle engines have been defined in previous supersonic cruise research (SCR) supported studies for possible application to commercial supersonic transport aircraft. The extended flow variability made possible by such engines require greater versatility of the inlet and exhaust nozzle than for conventional engines. The range of flexibility of all propulsion system components need to be defined such as to maximize internal thrust and minimize nacelle and interference drag throughout the flight regime. As part of the SCR program a study of the integration problem of the propulsion system will be made to identify technology requirements and advance the various component disciplines to the point where intelligent choices can be made. The effort involves in-house and contracted research on isolated inlets and nozzles as well as the mutual installation effects on complete airplane configurations. This effort will be a cooperative and coordinated endeavor of both Langley and Lewis Research Center.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70150

533-02-14

Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED FLIGHT EXPERIMENTS ADVANCED FIGHTER TECHNOLOGY INTEGRATION/F111 (AFTI/F-111)
L J Caw 805-258-3311

The objective of this program is to conduct a series of flight experiments Dryden Flight Research Center will operate an F-111 aircraft and conduct an investigation of the mission adaptive wing (MAW) as a part of the joint NASA Air Force AFTI-111 Program Dryden will participate in design review develop and operate instrumentation and define flight test plans

W81-70151

533-02-24

Hugh L Dryden Flight Research Center Edwards Calif
HIGH PERFORMANCE AIRCRAFT FLIGHT TEST SUPPORT
Berwin M Kock 805-258-3311

The objective is to provide flight test support for high speed aircraft experiments This will be accomplished by maintaining a baseline capability with a high performance aircraft that can be easily used to accommodate specific flight projects or experiments The baseline support will include contractor maintenance support instrumentation system operation basic maintenance and fuel

W81-70152

533-02-34

Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED FLIGHT EXPERIMENTS F-14 HIGH ANGLE-OF-ATTACK

H J Smith 805-258-3311

The objective of this project is to conduct a number of flight test experiments in cooperation with the Navy and other NASA Centers which will benefit the F-14 while enhancing NASA's high angle-of-attack (AOA) technology These experiments include an evaluation of an aileron-rudder-interconnect flying qualities investigation high AOA parameter identification simulation validation study engine-airframe compatibility study and an investigation of the F-14 air data system at high angles-of-attack

W81-70153

533-02-44

Hugh L Dryden Flight Research Center Edwards Calif
INTEGRATED RESEARCH AIRCRAFT CONTROL TECHNOLOGY

B M Kock 805-258-3311

The overall objective of the Integrated Research Aircraft Control Technology (INTERACT) project is to demonstrate through flight a generically applicable control development process for interactive propulsion flight control systems To exercise this process for interactive modes will be developed through which measurable improvements can be verified The control modes will be implemented on a high performance aircraft using hardware of convenience The project consists of three phases a study activity (Phase 1) the implementation effort for development of the flight system (Phase 2) and subsequent research flight testing (Phase 3)

W81-70154

533-02-64

Hugh L Dryden Flight Research Center Edwards Calif
AFTI/F-16

Shu W Gee 805-258-3311

The overall objective of the Advanced Fighter Technology Integration/F-16 (AFTI/F-16) program is to quantify the benefits and penalties of the individual and integrated technologies proposed to improve weapon system effectiveness and survivability by flight demonstration of air-to-air and air-to-surface offensive and defensive mission roles The Digital Flight Control System (DFCS) Integrated Flight/Fire Control (IFFC) and Pilot-Vehicle Interface (PVI) technologies are being implemented in a modified F-16 to allow flight evaluation of such non-classical control modes as direct lift and side force flat turn fuselage pointing and uncoupled independent control of aircraft rotation and translation The AFTI/F-16 airplane will be flight tested and evaluated by a joint Dryden USAF and contractor flight test team and will be operated and maintained by Dryden from Dryden facilities

W81-70155

533-02-73

Langley Research Center Hampton Va
DECOPULER PYLON FLIGHT DEMONSTRATION
W H Reed III 804-827-2265
(505-33-53)

A joint program between Langley Research Center and Dryden Flight Research Center has the objective to demonstrate the suppression of wing/store flutter using the decoupler pylon concept on an advanced high performance airplane The concept has been verified in wind tunnel studies The purpose of the flight studies is to subject the concept to the effects of the full flight environment including maneuvering and atmospheric gusts while assessing the alleviation of the store flutter problem and to evaluate the dynamic characteristics of the wing-store-decoupler pylon system The decoupler pylon will be designed and fabricated under contract and flight tested at the Dryden Flight Research Center The Langley Research Center will exercise technical management of the study

W81-70156

533-03-13

Langley Research Center Hampton Va
HIGHLY MANEUVERING AIRCRAFT TECHNOLOGY
W P Henderson 804-827-2676

The objective of this research is to promote and stimulate the application of new and innovative technologies in a multidisciplinary manner so as to exploit to the highest practical degree the synergistic potential of the new technologies for the design of future fighter aircraft A vital part of this research will be to support the ongoing NASA Highly Maneuverable Aircraft Technology (HIMAT) programs The study of the highly integrated canard-wing concept will be pursued with the objectives of defining the stability and control characteristics at high angles of attack Promising ideas for obtaining high aerodynamic performance for maneuvering fighter aircraft will be examined analytically and experimentally with primary emphasis on investigating their aerodynamic performance propulsion stability and control characteristics Representative promising concepts which will be incorporated into the basic canard-wing concept include a high aspect ratio two dimensional vectoring nozzles utilized to enhance the maneuvering performance of the aircraft or to provide control forces such that the large radar reflecting control surfaces can be eliminated and anti-spin devices The experimental studies will be conducted in the Langley 16 foot and full scale tunnel

Transport Aircraft Systems Technology

W81-70157

534-01-13

Langley Research Center Hampton Va
LAMINAR FLOW CONTROL

R J Muraca 804-827-2045

The broad objective of this laminar flow control (LFC) element of the NASA Aircraft Energy Efficiency (ACEE) program is to develop and demonstrate a practical reliable maintainable laminar flow control system for viscous-drag reduction of future commercial transport aircraft The technology developed will be applicable to although insufficient for military transports The LFC element of ACEE consists of three separate but related phases (1) definition of candidate LFC system concepts for application to future production aircraft (2) subsystem development and evaluation and (3) design fabrication and flight demonstration of integrated LFC systems in a validator aircraft The Phase 1 effort was concluded in September of 1978 The Phase 2 activities which are to be accomplished in fiscal years 1979 through 1984 are covered by this RTOP

W81-70158

534-01-14

Hugh L Dryden Flight Research Center Edwards Calif
LAMINAR FLOW CONTROL (LEADING EDGE GLOVE) - FLIGHT RESEARCH

R S Baron 805-258-3311

The objective is to demonstrate by flight research the effectiveness of LFC leading edge system under representative flight conditions up to Mach 0.8 and 40 000 feet Two different

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

contractor LFC Leading Edge Systems (including suction cleaning and deicing systems) will be installed in the leading edge of both wings of the JetStar Aircraft. The LFC Leading Edge test articles will be designed and fabricated to demonstrate that required LFC systems can be packaged into a leading edge section of a wing representative of future LFC commercial transport aircraft. After the test articles are installed in the aircraft a series of ground and flight tests will be performed to insure the laminar flow performance and also to verify operational capability of the LFC contractor systems.

W81-70159 534-02-11

Ames Research Center Moffett Field Calif

ENERGY EFFICIENT TRANSPORT WIND TUNNEL TESTING

Frank W Steinle 415-965-5850

(534-02-03)

Technical assistance consultive services and support through the use of NASA-Ames facilities will be provided to NASA-Langley for the Energy Efficient Transport Project (EET). Support tests will be primarily conducted in the Ames 11- by 11-Foot Transonic and 12-Foot Pressure Wind Tunnels.

W81-70160 534-02-13

Langley Research Center Hampton Va

ENERGY EFFICIENT TRANSPORT

R V Hood 804-827-2396

This project will expedite industry acceptance and application of Advanced Aerodynamics and Active Controls Technology in an integrated manner to achieve significant energy, economic and aircraft sales benefits. In-house and industry experimental and analytical efforts will be continued in the areas of supercritical aerodynamics, high-lift systems, propulsion/airframe integration and wing/empennage/flight control systems. The industry activities are oriented both at near term derivative aircraft product improvements and farther-term new aircraft development. The in-house activities are generally focused on the longer-term new generation aircraft technologies that have higher potential benefits with commensurately higher risk. Emphasis will be placed on technologies having the greatest benefits to long-haul subsonic derivatives and new transport aircraft.

W81-70161 534-02-14

Hugh L Dryden Flight Research Center Edwards Calif

ENERGY EFFICIENT TRANSPORT FLIGHT RESEARCH

M R Barber 805-258-3311

This RTOP covers three separate elements as follows: (1) flight tests of Whitcomb Winglets on a KC-135 aircraft; (2) development of a system integration technique resulting in the design of an active control system that will provide gust alleviation, maneuver load control and flutter suppression for the Aeroelastic Research Wing Vehicle (ARW-2); and (3) determination of the extent of natural laminar flow that can be obtained with promising consistency on a subsonic cruise airfoil designed for favorable pressure gradients.

W81-70162 534-03-13

Langley Research Center Hampton Va

COMPOSITE COMPONENTS TECHNOLOGY

H L Bohon 804-827-3081

The objective of the composite components program is to accelerate the introduction of composite structures in commercial transport aircraft. This will be accomplished through the progressive introduction of selected components in current aircraft production. Design technology for typical secondary structure components and medium sized primary structures will be developed. Manufacturing processes suitable for production will be developed and verified through comprehensive ground testing. Several articles manufactured will be placed in flight service for subsequent long term evaluation.

W81-70163

534-03-33

Langley Research Center Hampton Va

LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES (LCPAS) - KEY TECHNOLOGY

H L Bohon 804-827-3081

(534-03-13)

The composite Primary Aircraft Structures (CPAS) program is intended to provide the technology experience and confidence so that commercial transport manufacturers can commit to production of composite structures in their future aircraft. The ongoing CPAS program has been highly successful in accelerating composites application in lightly loaded secondary structures of current and new commercial aircraft. In this new related program major emphasis will be placed on long lead key technology issues critical to the eventual application of composites to primary wing and fuselage structures. Contracts will be initiated with the major airframe manufacturers to develop and demonstrate satisfactory resolutions to specific preselected technology issues. These resolutions will provide the thrust for a major Larger Composite Primary Aircraft Structures Technology program.

W81-70164

534-04-13

Langley Research Center Hampton Va

TERMINAL CONFIGURED VEHICLE PROGRAM

James E Stitt 804-827-3745

(505-07-31)

The Terminal Configured Vehicle (TCV) Program is an advanced technology development activity focused on Conventional Takeoff and Landing (CTOL) Transport Aircraft that will need to operate effectively in reduced weather minima in the future high-density airspace environment using the new navigation aids, surveillance and landing systems and traffic management procedures under development by the DOT/FAA. The broad objective of the program is to develop and evaluate advanced flight management concepts, procedures and avionic systems which, when applied to commercial aircraft, could improve airport and airway capacity, aircraft efficiency and air crew effectiveness. The activity involves research, analysis, mission simulations and flight studies using extensive facilities located at Langley, Wallops Island, FAA/NAFEC and FAA-designated controlled airspace. A modified B-737 airplane equipped with highly flexible display and control systems is being used to study and exploit the full operating potential of advanced ATC systems in simulated future terminal area environments. These studies will be performed with active participation by major airframe manufacturers and in cooperation with the DOT/FAA and DOD and representatives of major airlines.

W81-70165

534-04-18

Wallop Flight Center Wallops Island Va

WALLOPS FLIGHT CENTER RESEARCH AIRPORT SUPPORT

Donald L Feller 804-824-3411

This RTOP covers the FY-81 program support costs associated with OAST programs that use the facilities of the Wallops Flight Center research airport and other supporting services. Included are ADP operations, SAR, chase and other aircraft flight services, crash fire and rescue services, control tower management of Wallops Flight Center control zone, program aircraft ground servicing, shop support, specialized instrumentation and miscellaneous equipment.

W81-70166

534-05-17

Lyndon B Johnson Space Center Houston Tex

FIRE SYSTEMS FULL-SCALE TEST

D E Supkis 713-483-3211

(505-44-27)

The efforts defined in this RTOP consists of work originated in FY-75. The RTOP provides for the procurement of manpower for testing aircraft seats fabricated with newly-developed materials in the JSC 737 fuselage, preparing the 737 fuselage and fitting it with instrumentation for conducting full-scale flammability tests, computer support and evaluation analysis and delivery of technical data and reports.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Advanced Propulsion Systems Technology

W81-70167

535-01-12

Lewis Research Center Cleveland Ohio
ENERGY EFFICIENT ENGINE PROJECT
Neal T Saunders 216-433-5594
(511-54-01 510-53-01 505-04-02)

The objective of the Energy Efficient Engine project is to develop and demonstrate technology for a next-generation turbofan engine having 10 to 15% lower specific fuel consumption at least a 50% reduction in rate of performance deterioration at least 5% reduction in direct operating cost and reduced emissions and noise levels as compared to current high-bypass turbofan aircraft engines. Initial program efforts included preliminary engine design and integration studies through contracts with two major aircraft engine manufacturers. On the basis of these studies and associated airframe and airline evaluations engine cycles and configurations that best meet project goals were identified. The major part of the project was then initiated with award of parallel component development and integration contracts to the same two engine companies. These latter contracts emphasize the advancements in component and systems technologies required for possible future commercial development of more energy efficient engines. Advanced engine components are being designed and developed and performance will be verified by rig tests. The high-spool core system will be designed fabricated and tested to evaluate its performance characteristics and to further refine the design of the components. The low-spool assembly will be integrated with the core to evaluate two-spool integrated performance and mechanical systems performance.

W81-70168

535-02-12

Lewis Research Center Cleveland Ohio
VARIABLE CYCLE ENGINE TECHNOLOGY
Albert G Powers 216-433-4000
(533-01-32 533-01-62)

This program will develop the critical low-spool component technologies unique to variable cycle engines for future advanced supersonic cruise aircraft. Component and system performance and environmental characteristics will be demonstrated and evaluated both statically and in a simulated low-speed flight environment. This program will build upon the results of the VCE Component Program and will provide validation of much of the low-spool technology. It will continue to emphasize acoustic technology and a major milestone in the program will be a large scale jet noise test at simulated flight conditions in the NASA Ames 40 x 80 Foot Wind Tunnel. This program will expand the development and evaluation of the Variable Stream Control Engine (VSCE) and the Double Bypass Engine (DBE) through contracted efforts. Specifically the program will broaden the nozzle aero/acoustic performance data base over a wide range of aircraft flight conditions through a series of model nozzle tests. Emphasis will be on coannular nozzle systems including mechanical suppressors thermal shields etc to meet FAR 36 stage 3 noise goals. Critical low-spool components will be developed through component rig tests and will then be integrated into engine system demonstrations to verify their performance and environmental characteristics. System testing including noise measurements in a low-speed simulated flight environment will be accomplished to verify at large scale that the coannular noise benefit is maintained in a forward velocity field.

W81-70169

535-03-12

Lewis Research Center Cleveland Ohio
ADVANCED TURBOPROP PROGRAM
James F Dugan 216-433-4000
(535-03-11 535-03-13 535-03-14 530-05-12)

The objective of the Advanced Turboprop Program is to develop technology for efficient reliable and acceptable operation of advanced turboprop powered aircraft at cruise conditions comparable to those of current turbofan powered aircraft. The Advanced Turboprop Program will be implemented in three phases. In Phase I (funded in FY1978 thru 1980) a fundamental

data base on small scale models was developed and the feasibility of the high-speed (Mach 0.7 to 0.8) turboprop concept was established. This RTOP primarily covers Phase II of the program. In Phase II the principal objective is to establish the fabrication and structural integrity of large scale high-speed propellers of advanced aero-acoustic design. Large-scale propeller technology for diameters of 8 feet or greater will be developed. Static, low speed and high-speed flutter and excitation tests will be made for the experimental propeller system using a modified gas turbine drive. While the primary emphasis in Phase II will be on the structural integrity of large-scale high-speed propellers there will also be work in other technology areas. Conceptual engine design and preliminary designs of advanced gearboxes and pitch change systems will be evaluated. The development of fuselage acoustic technology will continue with tests and upgrading of analytical tools. Also further aerodynamic tests and analyses of turboprop aircraft model configurations will be conducted.

W81-70170

535-03-13

Langley Research Center Hampton Va
ADVANCED TURBOPROP-INTERIOR NOISE
D G Stephens 804-827-3561
(505-33-53)

The objective of this program is to demonstrate technology readiness in the area of acoustics and noise reduction for advanced turboprop aircraft development. Configurations of interest are aircraft powered by highly loaded multibladed turboprops for efficient high-speed operation. Program emphasis is on propeller noise and fuselage attenuation technology. The approach consists of the development of improved analytical and experimental methods for predicting propfan noise both in the near field and the far field and for predicting the transmission of noise through the cabin sidewall. These prediction methods are being developed and validated by means of model tests during the Enabling Technology phase (I) of the program. The improved prediction methods will be used to guide the design of low-weight high-attenuation sidewalls for passenger acceptance and the design of propfans for acceptable fuselage as well as community noise exposure. The sidewall and propeller configurations resulting from acoustic considerations will be validated by small-scale and large-scale testing in Phase II of the ATP program and by flight tests during phase III of the program.

W81-70171

535-03-14

Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED TURBOPROP - FLIGHT RESEARCH
R S Baron 805-258-3111
(535-03-01 535-03-12 535-03-13)

The objective is to develop and demonstrate by flight research the technology for advanced turboprop propulsion systems having high propulsion efficiencies at cruise speeds and altitudes up to Mach 0.8 and 35 000 feet. This technology could provide fuel savings of 15 to 20 percent relative to advanced high-bypass turbofan engines while meeting reliability requirements and environments noise constraints. Two-foot diameter scale models of advanced high tip speed propellers will be installed on a JetStar aircraft capable of flying Mach 0.8 at 30 000 feet altitude. Microphones will be placed on wing and fuselage and acoustic flight research will be performed to obtain near field noise data. A study will be conducted of the B-52 as a test bed for large-scale turboprop testing examining in depth the options for mounting the attainable data and the related costs.

Numerical Aerodynamic Simulator

W81-70172

536-01-11

Ames Research Center Moffett Field Calif
NUMERICAL AERODYNAMIC SIMULATOR (NAS PROJECT)

M S Johnson 415-965-6479

The primary objective of the NAS Project is to design and develop a unique large scale high performance computational resource for solving viscous three dimensional fluid flow equations specially oriented toward the solution of aerodynamic or fluid dynamic problems. A secondary objective is to generalize the computational resource for application to a broader scope of problems of interest to NASA.

Space Research and Technology Base

Aerothermodynamics Research and Technology

W81-70173 506-51-11
 Ames Research Center Moffett Field Calif
COMPUTATIONAL AND EXPERIMENTAL AEROTHERMODYNAMICS
 J G Marvin 415-965-5390
 (506-54-41)

The objective is to establish aerothermodynamic technology and configuration design concepts to improve vehicle safety reliability versatility and aerodynamic efficiency with maximum payload for earth-orbital missions and planetary exploration Advanced computational methods and computer codes will be developed for predicting vehicle flow fields and performance Turbulence models (used in these computer codes) will be developed from building block numerical and physical experiments New instrumentation techniques will be developed for the measurement of turbulence quantities in 3-dimensional flow fields

W81-70174 506-51-13
 Langley Research Center Hampton Va
SPACE VEHICLE AEROTHERMODYNAMICS AND CONFIGURATION TECHNOLOGY
 J P Arrington 804-827-3911

The objective of this study is to develop configuration design concepts and the associated aerothermodynamic technology data base which will allow the achievement of space transportation vehicles operational in the 1990's and beyond which offer significant improvement in operational efficiency economy and safety The intent is to study both analytically and experimentally configuration concepts utilizing technologies advanced beyond the base being established by the Space Shuttle Specific studies will be directed toward solution of the aerothermodynamic problems associated with these concepts in such areas as aerodynamic performance viscous-interaction and real-gas effects vortex interactions heat transfer basic configuration shaping and optimization Computational flow-field methods will be developed with emphasis on realistic configurations and techniques for integrated configuration design analysis and optimization will be developed and continuously improved Feasibility studies of the use of the Space Shuttle Orbiter to obtain fundamental aerothermodynamic data applicable to future vehicle design will be pursued Various perfect gas and real-gas facilities will be utilized in experimental investigations to provide design data over a broad range of parameters If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70175 506-51-21
 Ames Research Center Moffett Field Calif
PLANETARY PROBE AEROTHERMODYNAMIC TECHNOLOGY
 H K Larson 415-965-5369

This effort is directed at providing the aerothermodynamic technology base in high-speed aerothermodynamics required for the design development and verification of probes entering planetary atmospheres and to provide computational and experimental support in a timely manner for the specific development of planned and approved missions in accord with the following targets (1) to provide a complete understanding and prediction of the shock-layer and ablation product radiative gasdynamics for planetary entry vehicles (2) to provide coupled flow field ablation solutions for outer planet probes and (3) to support the aerodynamic development of planetary probe configurations and to provide the flight mechanics data in support of atmospheric reconstruction experiments The coupled nature of outer planet probe aerothermodynamics requires a highly integrated computational and experimental program The

theoretical and experimental efforts in the area of shock-layer radiation must be coupled with similar efforts in ablation product radiation and absorption These efforts in turn must be coupled with research associated with shock layer flow which is highly blown by ablation products In addition the flight mechanics of the probe both static and dynamic are significantly affected by the ablation mass loss and shape change Finally all these theoretical efforts and experimental validations must provide the required aerothermodynamic input to outer planet probe development

W81-70176 506-51-23
 Langley Research Center Hampton Va
PLANETARY PROBE TECHNOLOGY
 J J Jones 804-827-3031
 (506-51-13 506-51-33)

This work encompasses computational and experimental support for advanced mission planning for possible future planetary entry vehicles as well as direct support for approved missions The only presently approved probe mission is the Galileo Project to Jupiter The delay in planned launch date for Galileo leaves open the possibility that additional support will be required in FY-81 It is expected however that most of the work will address future missions such as Saturn and Titan Venus aerocapture and aeromaneuvering vehicles While the mission support is developmental in nature aimed toward specifying heat-shield requirements and aerodynamic performance for a given configuration the work for future missions is basic in nature--analyzing thermodynamic and transport properties of various gas mixtures and species developing computation techniques for viscous and noncontinuum regimes or techniques for flow-field computations over new configuration classes such as bicones Work is primarily in-house with contractual assistance in some areas If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70177 506-51-31
 Ames Research Center Moffett Field Calif
OEX FLIGHT DATA ANALYSIS
 H K Larson 415-965-5369
 (506-63-05 506-63-06)

This effort is directed to provide the gasdynamic and aerothermodynamic technology base that is required to analyze the aerothermodynamic data of flight origin from Shuttle Shuttle launched entry research vehicles or engineering experiments on NASA atmospheric entry missions to improve aerothermodynamic design techniques for new vehicles and to enhance the aerothermodynamic efficiency of the Shuttle This will be accomplished by addressing the following targets (1) to compare data from infrared imagery of Shuttle (IRIS) and development flight instrumentation (DFI) with Shuttle design techniques and advanced flowfield computations (2) analysis of data on catalytic wall effects to compare with computations of reacting flows (3) analysis and correlation of tile gap heating data and (4) comparison of data from Shuttle infrared leeside temperature sensing (SILTS) with advanced leeside flow field computations

W81-70178 506-51-33
 Langley Research Center Hampton Va
AERODYNAMIC/AEROTHERMODYNAMIC FLIGHT DATA ANALYSIS
 J J Jones 804-827-3031
 (506-51-14 506-51-23)

The objectives of this work are to carry out analyses of aerodynamic and aerothermodynamic flight data and to compare the results with pertinent ground test data and theoretical methods to assess the adequacy and accuracy of theory and the techniques used to extrapolate wind-tunnel data to flight conditions to define areas where improved methods facilities or additional flight data are needed in order to make reliable predictions of flight aerothermodynamic properties and to identify areas for significant improvements in future orbiter modifications Shuttle orbiter entry data will be analyzed beginning with the first orbital flight making use of such instrumentation data as are available on a given flight A best estimated trajectory will be computed and used in extracting coefficients Meteorologi-

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

cal data will be combined with the trajectory information to determine free-stream state Thermocouple and calorimeter data will be used to determine time-dependent heating-rate distributions If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70179 **506-51-34**

Hugh L Dryden Flight Research Center Edwards Calif

SPACE SHUTTLE AERODYNAMIC EXPERIMENTS

T G Ayers 805-258-3311

The objective of this RTOP is to investigate the use of Shuttle Entry Air Data System (SEADS) type flush mounted pressure orifice and auxiliary flush orifices for air data measurements at subsonic and transonic speeds It will also extend the applicability of currently available mathematical tools for determination of digital flight control system stability and control performance structural and atmospheric turbulence characteristics in the reentry environment where aerodynamic data are virtually nonexistent

Chemical Propulsion Research and Technology

W81-70180 **506-52-12**

Lewis Research Center Cleveland Ohio

LIQUID-CHEMICAL PROPULSION TECHNOLOGY

Richard J Priem 216-433-6225

The objectives are to provide the technology for improving performance and reusability of liquid rockets and to obtain an improved understanding of basic chemical and physical processes for advanced chemical propulsion systems The work is divided into three areas (1) general advanced research and technology analytical and experimental programs will be conducted to improve the understanding of combustion phenomena thrust chamber life advanced cooling techniques and improved design techniques for more reliable chambers (2) low thrust chemical propulsion system - studies will be conducted to define propulsion system requirements develop parametric performance and cooling information evaluate small pump technology requirements and analyze low gravity fluid system components crucial to overall vehicle performance and (3) high density hydrocarbon fuel-LOX engine programs will be conducted to improve engine performance thrust chamber cooling and engine service life with minimum servicing and maintenance and turbomachinery performance and life

W81-70181 **506-52-17**

Lyndon B Johnson Space Center Houston Tex

ADVANCED MANNED VEHICLE ONBOARD PROPULSION TECHNOLOGY

R W Polfka 713-483-5495

The objective of this effort is to identify viable propulsion system designs and propellant alternatives which could replace N2O4/MMH in a second generation Shuttle auxiliary propulsion system or similar advanced spacecraft propulsion systems and to establish the technology base necessary to allow for future systems development Phase out of N2O4/MMH may become necessary due to handling health hazards high propellant cost and high corrosivity of these propellants The oxygen hydrocarbon propellant family provides the most attractive alternative Oxygen hydrocarbon type propellants will be characterized and system design and trade studies conducted Propellant and design selections will be made and critical component technology and technology issues will be identified Component technology will be developed and carried forward into assembly level test evaluation

W81-70182 **506-52-19**

Marshall Space Flight Center Huntsville Ala

ADVANCED REUSABLE MAIN ENGINE TECHNOLOGY

Robert J Richmond 205-453-3710

Oxygen/hydrocarbon and oxygen/hydrogen systems required for advanced high pressure engines for future booster vehicles

and for advanced main propulsion engines for future orbit-to-orbit vehicles are being investigated Single-fuel and dual-fuel dual-throat engine concepts are being examined The activities described include engine power cycle synthesis parametric data generation, component performance prediction and evaluation injector/combustor design and fabrication combustor and turbine cooling investigation These efforts include data screening analyses design computer modeling hardware fabrication data evaluation and test

W81-70183 **506-52-25**

Jet Propulsion Laboratory Pasadena Calif

HIGH ENERGY CHEMICAL PROPULSION TECHNOLOGY FOR PLANETARY SPACECRAFT

Winston Gin 213-354-3575

(506-62-35 506-53-36)

This RTOP supports the PASO specific objective of providing technology for advanced propulsion onboard planetary spacecraft including both chemical liquid and solid propellant systems This effort will provide the technology base for the highest practical performance liquid propellant propulsion system - a pump-fed space-storable system using liquid fluorine The general approach will utilize both analysis and experimental techniques which include engine testing Specifically the approach is to develop a small pump which is compatible with fluorine but will be characterized first with an earth-storable engine and subsequently with a space storable liquid fluorine-hydrazine engine Research which supports this technology will be done in materials compatibility especially in long term exposure to fluorine and in the nature and effects of nozzle vacuum exhaust plume dynamics of fluorine-hydrazine combustion products The target for completion of the all-up system test (technology readiness) of a pump-fed fluorine-hydrazine system with a high-pressure engine is FY-87 The objective is to add to the technology base of a solid propulsion system which incorporates an energetic nitramine oxidizer HMX The approach will involve a combination of study and experimentation including complete motor testing Experimentation specifically involves processability ballistics aging stability thermal stability and combustion stability of the next generation of Shuttle IUS and spacecraft injection stage propellants which use HMX nitramine oxidizers A special activity will be the completion of the heat-sterilizable solid propellant motor program in FY-81 The target for the completion of the energetic solid propellant work is FY-85 when it may be expected that HMX will be incorporated in the Shuttle IUS

W81-70184 **506-52-30**

National Aeronautics and Space Administration Washington D C

CHEMICAL PROPULSION RESEARCH SUPPORT

F Stephenson 202-755-3274

The objective of this task is to maintain up-to-date information gathering capability on the nation's total chemical propulsion technology effort which is of great benefit in planning and directing the NASA-wide effort The approach will be to share support of the Chemical Propulsion Information Agency (CPIA) which supplies this service with the DOD agencies through the Joint Army Navy NASA Air Force (JANNAF) Interagency Propulsion Committee

W81-70185 **506-52-35**

Jet Propulsion Laboratory Pasadena Calif

ADVANCED CHEMICAL PROPULSION CONCEPTS FOR PLANETARY SPACECRAFT

Winston Gin 213-354-3575

(506-52-23 506-62-35)

This RTOP supports the PASO specific objective of exploring new chemical propulsion concepts that promise significant increases in performance over conventional chemical rocket propulsion This effort will identify and then develop new concepts to provide ultra-high performance chemical rocket propulsion with specific impulse in the 600-800s range at moderately low thrust levels The costs involved with long duration missions to the outer planets where high escape velocities and thus high specific impulse propulsion are required must be decreased These missions can be supported by electric propulsion However

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

because of the very low thrust of electric propulsion systems flight times which translate into long mission support times and costs are very long, so that a higher thrust system without a great mass fraction or specific impulse penalty is needed. The approach is to evaluate advanced propulsion concepts such as metastable compounds free radicals electrical augmentation select promising concepts and get bench level and breadboard experimental results in both specific impulse and mass fraction. This work will demonstrate techniques which will produce propellants using resources natural to selected extraterrestrial bodies. The justification for studying the manufacture of propellants at the planets and their satellites is to reduce the consumables which must be carried from Earth. Enabling missions can result which use in-situ manufactured propellant for planetary take-off return to earth or refueling stations. The approach for extraterrestrial propellants is laboratory demonstration of production of oxygen and methane from Martian CO₂ and H₂O and mission studies of propellant production at satellites of the outer planets. The target for completion of the laboratory demonstration for oxygen production is the end of FY-83.

W81-70186 **506-52-39**

Marshall Space Flight Center Huntsville Ala
PLUME CHARACTERIZATION

R J Richmond 205-453-3710

A chapter dealing with plume contamination effects for the JANNAF Plume Technology Handbook and a low altitude rocket plume flow field prediction computer program are being developed. Existing computer programs and experimental data dealing with all areas of plume technology are being reviewed and documented in a JANNAF Plume Technology Handbook. The present year's effort is directed at preparing the chapter on plume contamination effects. A streamlined low altitude rocket plume flow field computer program or set of programs will be developed by combining the best features of the existing programs into one new program.

Materials and Structures Research and Technology

W81-70187 **506-53-10**

National Aeronautics and Space Administration Washington D C

SPACE ENGINEERING

Michael A Greenfield 202-755-2364

The objective of this RTOP is to provide a fundamental research program to obtain an understanding of the effective use of space vehicles and exploration of space. The program will concern itself with novel structural forms human productivity in space and maintenance of the geometric tolerances of large space structures. It will employ both graduate research assistants and undergraduates utilize independent studies as an opportunity to develop the necessary skills of a qualified space engineer and will help fund the experimental projects laboratory at MIT.

W81-70188 **506-53-11**

Ames Research Center Moffett Field Calif

SURFACE PHYSICS AND COMPUTATIONAL CHEMISTRY
J O Arnold 415-965-6209

The objective is to develop a detailed understanding of the mechanisms which control important properties of matter and how they are modified by a wide range of environments. This understanding is leading to the development of new materials and processes needed by the agency. Properties of metallic interfaces are being determined by probing their structure at the atomic level. Knowledge of surface/environment interactions is being improved by studying gaseous surface reactions and how they relate to microscopic materials properties. Work is underway on feasibility studies for mapping hydrogen concentrations on metal surfaces. The atomistic structure and properties of epitaxially absorbed layers of metallic and semiconducting materials on well defined substrates is being investigated. The physical and chemical properties of molecules and small atomic

clusters (5-14 atoms) are being calculated using state-of-the-art wavefunction computer codes. These quantum mechanical results for the small clusters which represent small bits of material are extrapolated by classical mechanics to determine surface and bulk properties of materials. Improvements in precision code optimization and approximate methods are allowing larger systems to be studied and thus requiring smaller extrapolations to obtain surface and bulk properties. This also helps to elucidate the manner in which properties of atomic clusters approach those of the bulk material. These calculations are currently being used to investigate chemisorption diffusion corrosion hydrogen-induced crack growth and the properties of catalytic particles.

W81-70189

506-53-12

Lewis Research Center Cleveland Ohio

MATERIALS SCIENCE

S J Grisaffe 216-433-4000

The objectives are to develop greater understanding of materials with aerospace propulsion and power potential and to thereby develop guidelines for improving their physical and mechanical properties. Fundamental materials studies are aimed primarily at determining the mechanisms limiting material performance and useful material life as well as at identifying scientific concepts which might be applied to substantially improve such materials. The focus includes studies of the compositional influence on toughness of intermetallic aluminides and on thermal fatigue resistance of superalloys metallic composite and fiber strengthening ion exchange chemistry of battery separator membranes the basics of friction wear and adhesion the chemistry and morphology of solid and liquid lubricants and the fatigue behavior of potential bearing and gear materials.

W81-70190

506-53-15

Jet Propulsion Laboratory Pasadena Calif

FUNDAMENTALS OF MECHANICAL BEHAVIOR OF COMPOSITES MATRICES

J Moacanin 213-354-3178

The long-term objective seeks to develop a fundamental understanding at the molecular level of organic matrix composites used in current and planned space and primary airframe structures. Applications for this research are aimed at the evaluation of long-term performance of advanced composites as well as of the adhesively bonded interfaces and will support advanced space power and transportation systems and large space structures. From correlations of molecular parameters with observed mechanical properties and failure mechanisms of composite materials strategies will be developed for seeking molecular structures and composite systems which would exhibit higher performance longer life and lower cost. Although the reinforcing fiber controls strength it is the matrix that plays a dominant role in the control of fatigue life because failure occurs either in the matrix or at the matrix-fiber interface. In FY81 the focus will be on the development of the understanding of molecular dynamics of processes that control matrix behavior. Aspects of the macroscopic description of behavior will be continued. The approach includes determination of the time-temperature dependence of engineering properties (e.g. Poisson's ratio and creep compliance) as function of chemical composition morphology process history and physical and environmental aging. Fundamental aspects of chemical degradation processes will be investigated using electron spin resonance (ESR), spectroscopy and related techniques to identify and characterize transient species induced by thermomechanical stresses.

W81-70191

506-53-17

Lyndon B Johnson Space Center Houston Tex

REFINING OF NONTERRESTRIAL MATERIALS

R J Williams 713-483-2781

These studies are designed to provide data on chemical and physical processes which might be used to extract silicon and glasses from lunar rocks and soils for ultimate use in constructing and supporting space projects. Laboratory experimentation will be used to measure the physical and chemical characteristics and the efficiencies of processes which can extract useful materials from lunar rocks and soils. The research will be confined to laboratory study at the bench-top scale and will

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

concentrate on measurement of basic physics and chemistry involved. Three areas of study will be the recovery of silicon from rocks and minerals using hydrofluoric acid leaching separation of anorthite from soils and recovery of oxygen from carbonaceous gases by electrolysis. Making of foamed glasses and glass composites using oxygen will be a fourth area for later study. All studies will be pursued by studying the output of a process as successively more complex starting materials are used.

W81-70192 **506-53-23**
Langley Research Center Hampton Va
COMPOSITES FOR ADVANCED SPACE SYSTEMS
D R Tenney 804-827-2434
(533-01-13 505-33-33 506-62-43)

The objective of this research is to develop durable composites for long-life service in future space systems and advanced space transportation systems. To determine the space durability of advanced resin matrix composites electron and proton radiation exposures will be conducted using appropriately equipped laboratories to simulate the natural space environment. Theoretical models will be developed to predict the effects of space exposure on structural composites and will be verified with experimental data. Radiation damage mechanisms will be identified to guide new materials development. For higher temperature applications graphite/polyimide and metal-matrix composites such as SiC/Ti, Gr/Mg, Gr/Al will be developed and subjected to thermal, environmental and mechanical cycles. Fabrication procedures will be established for each system developed and preliminary design allowable data generated. To determine the response of composites to cyclic loading a generic fatigue methodology will be developed wherein only data from simple laminates or lamina are needed to evaluate material constants and the changes in the constants under repeated fatigue loads. Basic studies of molecular properties will be investigated to better characterize defects in materials.

W81-70193 **506-53-25**
Jet Propulsion Laboratory Pasadena Calif
EFFECTS OF SPACE ENVIRONMENT ON COMPOSITES
J Moacanin 213-354-3178

The long-range objective is to develop ultrafast pulse radiolysis as a tool for the determination of primary degradation processes caused by charged particles and to ultimately use this information along with conventional high energy exposure material test data to develop a reliable methodology for estimation of the long-term effects of the space environment on polymers and composites. The objective in FY-81 is to initiate development and validation of a predictive model of degradation for candidate materials such as epoxies, polyimides and polysulfones. Pulse radiolysis transient measurements will be used to determine rates of fast processes such as dissociation of a molecular ion, generation of an excited state from ion recombination or homolysis of an excited state generating a radical pair. Pulse radiolysis utilizing a pulsed electron beam and fast optical and ESR detection assemblies can monitor these types of fast processes and measure their rates. These data along with steady-state data will be used to develop analytical models of degradation and a reliable prediction technology for 20-year lifetime applications.

W81-70194 **506-53-29**
Marshall Space Flight Center Huntsville Ala
LONG-TERM SPACE ENVIRONMENTAL EFFECTS ON MATERIALS
R L Gause 205-453-1500
(910-38-20 506-16-22 506-16-25)

The objective is to evaluate the long-term effects of the space environment on candidate materials for future long-duration space programs. The approach will be to assess future long-term programs to define potential materials requirements from design definition and mission environment profiles. Candidate materials will be selected for evaluation. An environmental test matrix will be developed for these candidate materials from the materials requirements. An appropriate test program will be performed to acquire the required data. A Space Materials Design Guide will be developed.

W81-70195 **506-53-31**
Ames Research Center Moffett Field Calif
THERMAL PROTECTION SYSTEMS MATERIALS AND SYSTEMS EVALUATION
H K Larson 415-965-5369
(506-51-21 506-63-06)

The objective is to provide thermal protection systems concepts and materials for heat shields to protect earth and planetary entry vehicles and planetary probes during atmospheric entry. The specific objectives are to (1) develop improved fiber materials and minimum weight TPS to enhance the Space Shuttle and enable fully reusable advanced space transportation systems development; (2) develop planetary probe heat shield materials and determine methods to minimize heat shield weights; (3) develop concepts and heat shield materials for safe earth entry of radioactive power sources and to support DoD requirements. The system requirements for each end use are defined. Thermal protection materials parameters are determined that meet these requirements. Materials are either selected from the extensive technology in existence or new materials with optimized properties are developed. Candidate thermal protection concepts and materials are subjected to systematic analysis and testing to qualify them for the defined end use. Extensive unique Ames arc plasma test facilities developed for Space Shuttle and planetary entry probes are used in the experimental evaluations. Analytical studies are performed utilizing unique environmental computer codes developed by ARC that include detailed models of both the aerothermal environment and material response to obtain in-depth understanding of the material characteristics. Detailed temperature dependent radiation properties are computed for gaseous species required for thermal response analysis. Materials are often developed as a result of these studies to meet the ever more stringent requirements for atmospheric entry thermal protection.

W81-70196 **506-53-33**
Langley Research Center Hampton Va
THERMAL PROTECTION SYSTEMS FOR EARTH-TO-ORBIT STS
S C Dixon 804-827-3423
(505-53-73 506-53-63 506-53-33)

The objectives of this research are to provide heat shield testing to support the space shuttle program and to develop improved thermal protection system materials and concepts for advanced space transportation systems. Available arc-tunnel and other facilities will be used as required to validate the Space Shuttle TPS. If problems are discovered in the course of this testing, in-house programs will be undertaken to find solutions. Environmental exposure testing of RSI will continue. For advanced vehicles, new materials and concepts will be developed with emphasis on metallic materials. Emittance of high temperature alloys after exposure to flowing air will be determined. The possibility of increasing this emittance will be explored. High temperature creep will be studied; data will be generated on various alloys and a design methodology will be developed based on statistical analysis of the data. A model for cyclic creep will be developed. Thermomechanical processing techniques which improve creep resistance and other properties of materials will be evaluated. The possibility of developing a high performance carbon-carbon heat shield material will be explored. Metallic TPS concepts will be evaluated via tests in the 8-Foot High Temperature Structures Tunnel and the Thermal Protection System Test Facility.

W81-70197 **506-53-37**
Lyndon B Johnson Space Center Houston Tex
ADVANCED CARBON-CARBON STAND-OFF PANEL
D M Curry 713-483-2376

This RTOP provides for the procurement of a design, fabrication and test of a carbon-carbon stand-off panel using the advanced carbon-carbon material being developed by The Vought Corporation under a NASA Langley contract. Fabrication and testing of prototype hardware will accelerate carbon-carbon panel design concepts to obtain test data and to demonstrate weight and cost control.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY**W81-70198 506-53-39**

Marshall Space Flight Center Huntsville Ala
 THERMAL CONTROL SYSTEM TECHNOLOGY

J L Vaniman 205-453-1171

Space vehicles envisioned during the operational phase of the Space Transportation System (STS) will require thermal control in magnitudes and configurations beyond the capability of current technology. Development of new system concepts as well as new components will be required in a timely fashion to meet the needs of these vehicles. The purpose of the tasks described in this research and technology effort is first to develop components which will be vital to future thermal control systems (TCS). Upon completion of component design fabrication and testing, TCS elements will be integrated at the breadboard level to evaluate system performance and life characteristics. Finally, where appropriate, flight experiments will be developed to gather data and prove designs and concepts before incorporation into operational vehicles. Technology items and tasks will be grouped into several areas of concern. Thermal control surfaces will be developed to provide adequate performance for extended lifetimes. Components will be developed in the area of fluid and thermal interfaces to insure against leakage across rotating joints and to demonstrate necessary performance at high total heat loads and high watt densities. Heat pipe developments will be pursued in the areas of cryogenic thermal control of scientific instruments and improved radiator reliability for extended orbital lifetimes.

W81-70199 506-53-43

Langley Research Center Hampton Va
 ADVANCED SPACE STRUCTURES

M F Card 804-827-3054
(506-62-43)

Research will be conducted on advanced structural concepts for future large space systems. Efforts will include the development of generic spacecraft building blocks, advanced analysis and design techniques and preliminary planning of possible flight experiments. Concepts for producing very high density packaging in deployable structures will be investigated. Analysis and design efforts on structural sizing of generic platform and antenna studies will be continued with emphasis on very slender member effects. Experiments to identify critical problems in assembly of erectable structures will continue. Reassessments of dynamic instrumentation and test requirements for the SEPS experiment will be conducted. Work under this RTOP will be coordinated with more focused research under the Spacecraft Systems R and T Program.

W81-70200 506-53-53

Langley Research Center Hampton Va
 FAILURE AND THERMAL ANALYSIS

M M Mikulas 804-827-2551

Advanced structural analyses and design methods will be provided to predict accurately and economically the deformations, stresses, collapse and damage tolerance of future space structures. Theoretical analyses and design efforts include research on new equations to represent structural behavior and the development of algorithms to improve the efficiency of computational methods. Analyses will be developed to reflect and predict the failure modes observed in tests of damage tolerant composite structures. Emphasis will be on developing analyses to predict quantitatively the behavior of structures subjected to high static loads, cyclic loads, thermally-induced stresses and impact damage. Selected structures fabricated from several advanced material systems will be tested to evaluate the accuracy of the advanced analyses.

W81-70201 506-53-55

Jet Propulsion Laboratory Pasadena Calif
 OPTIMIZATION OF STRUCTURAL SYSTEMS

J A Garba 213-354-2085

The principal objective is to develop optimization methods and analytical tools for the efficient design of structural systems. The long range objectives are to develop optimization techniques considering interdisciplinary interactions in structural synthesis and to advance the state-of-the-art of optimization. The initial efforts will be centered around an existing state-of-the-art

structural synthesis program ACCESS-3. The computer program will be expanded to include capabilities which are essential to the efficient analysis and synthesis of aerospace structural systems. The activities will be collaborated with Prof L A Schmit of UCLA as consultant to the program and will be coordinated with personnel at LaRC who are conducting related work.

W81-70202

506-53-63

Langley Research Center Hampton Va
 LOADS, DYNAMICS AND AEROELASTICITY

M F Card 804-827-3054

The objective of this effort is to develop and validate analysis and test methods for the prediction and verification of structural response and stability in dynamic and thermal environments for use in the support of design optimization and qualification of space transportation systems and payloads. Work on structural dynamics is directed to the improvement of test techniques for large space structures and investigations of methods of providing active damping for such structures. Improved instrumentation and software to measure low-frequency response and to perform on-line dynamic data analysis will be developed. Complementary work in large space structures will be conducted on theoretical techniques for adaptive control and controller design. In work on aerothermal loads, heating and pressure effects on space transportation system structures will be investigated. Effects of surface variation, coves, wing/body and wing/elevon junctions will be studied in wind tunnel tests.

W81-70203

506-53-64

Hugh L Dryden Flight Research Center Edwards Calif
 LOADS, DYNAMICS, AND AEROELASTICITY

R A Fields 805-258-3311

Experimental data from laboratory tests of existing high temperature structures will be obtained and used to evaluate available computer analysis methods for prediction of temperatures, deflections and strains. These correlations will also be used to improve parametric information to aid future designs. It is anticipated that additional specimens will also be tested in this program as they become available from development programs at the Langley Research Center. Airloads obtained from calibrated strain gages on OV 101 and 102 will be compared with wind tunnel and theoretical predictions to evaluate flight measurement technique and analytical methods.

W81-70204

506-53-65

Jet Propulsion Laboratory Pasadena Calif
 SPACE VEHICLE DYNAMICS METHODOLOGY

J A Garba 213-354-2085

The principal objective of this five-year effort is to perform research and advanced development in dynamics criteria, design analysis and testing to develop and update analysis and test methods. Basic research will be performed in structural dynamics related to future problems such as large complex nonlinear space structures. These methods will be used for the prediction and verification of structural response and stability in support of advanced design optimization and qualification of space transportation systems and payloads. The activities will be coordinated with NASA headquarters, other NASA centers and the Dynamic Acoustic and Thermal Environment (DATE) Working Group chaired by GSFC. The task will utilize existing data from flight programs (Viking, Voyager and others) until the Shuttle Orbiter bay flight data are available. It is presently planned to support a Resident Research Associate during this fiscal year.

W81-70205

506-53-66

Goddard Space Flight Center Greenbelt Md
 PAYLOAD ENVIRONMENTS AND DYNAMICS

J P Young 301-344-8284

(506-63-36)

The overall objectives are to produce improved means for generating vibroacoustic environmental design and test specifications for STS payload components and to produce improved techniques for structural analysis of STS payloads. Specific objectives are to exercise and validate use of the VAPEPS computer program designed for efficient prediction of STS payload component random vibration environment to validate the PACES

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

program designed to predict STS payload bay acoustic environment to obtain/evaluate STS payload flight data that is specifically suited for providing verification of payload design loads and environmental prediction methods and to produce an improved technique for static and dynamic analysis of structures composed of many repeated identical modules. The approach is to input early STS payload flight data into the VAPEPS program and make component random vibration environment prediction for most immediate following flights to correlate measured flight acoustic data with PACES program predictions to serve as the Principal Investigator for the LDEF/SBEM acoustic environment measurement experiment via the DATE Working Group activity plan and manage the acquisition processing and utilization of STS payload flight data to evaluate the relative importance of random vibration induced loads with respect to liftoff low frequency transient induced loads and to develop a technique for reducing computer secondary storage requirements for analysis of structures composed of many repeated modules

W81-70206 **506-53-69**
Marshall Space Flight Center Huntsville Ala
SPACE VEHICLE DYNAMICS
R S Ryan 205-453-2481

The objective is to continue the development of techniques for predicting the dynamic response of space transportation systems and payloads. Several tasks will contribute to the accomplishment of this objective. A continuing task will be to update the vibroacoustic reference data banks with Space Shuttle/payload flight and test response data and to enhance computerized data storage/retrieval capabilities. Vibroacoustic prediction techniques that combine classical model approach finite element modeling and component mode synthesis will be developed. A unified approach to predicting acoustic environments for both engine-generated and aerodynamically generated noise will be developed. Methods of analyzing complex structures and providing dynamics data to users will be developed. The method developed will provide the accuracy and efficiency required to generate design data within cost and time constraints. An optimized short cut methodology for payload loads assessment will be developed and validated. The methodology will key levels of analytical resolution to the state of payload development i.e. preliminary loads, intermediate loads or final loads cycle. The following major tasks are being undertaken to accomplish the objective: (1) development of Shuttle/payloads structural vibroacoustic data bank development of (2) improved structural and fluid dynamic analysis capability, and development of (3) acoustic environmental accuracy requirements for response determination and development of payload loads

Electronics and Automation Research and Technology

W81-70207 **506-54-41**
Ames Research Center Moffett Field Calif
PHOTOPHYSICS AND LASER DIAGNOSTICS
R L McKenzie 415-965-6158
(506-51-11)

The objective is to incorporate modern laser technology and photophysics in a program to develop photodiagnostic techniques for the characterization of gaseous media in a dynamic state. In most cases the gas will be flowing and may also be dynamically unsteady and thermally or chemically out of equilibrium. In the near-term primary emphasis continues to be placed on the measurement of turbulent fluctuations in the state variables of cold transonic and supersonic wind tunnel flows. For the longer term a secondary activity involves the spectroscopy of small molecules and their quantitative detection in concentrations as low as parts per billion. Primary experimental techniques are those unique to laser spectroscopy. Initial applications will be on important species common to combustion processes and to the fluorocarbon chemistry of the stratosphere

W81-70208 **506-54-42**
Lewis Research Center Cleveland Ohio
ELECTROPHYSICS
R E Alexovich 216-433-6689
(506-61-22 541-02-12 650-60-22)

The objective of this RTOP is to develop technology concepts and components for improving life reliability and performance of microwave electron beam and solid state amplifiers. To pursue this objective research and technology development programs will be undertaken on various components of microwave amplifiers such as high current density thermionic and field emission type cathodes, beam forming and confining devices and materials for solid state devices reliability

W81-70209 **506-54-43**
Langley Research Center Hampton Va
QUANTUM ELECTRONICS DEVICES AND SENSORS
S L Ocheltree 804-827-2791
(506-61-33)

The broad objective of this research is to discover, investigate and develop new and novel electro-optic materials, devices and sensors involving lasers, modulators, photodetectors, integrated optical circuits, fiber optics and optical signal processing, transfer and storage. New ideas are selected on the basis of their potential to provide the substantial increases in lowered costs, higher performance and reliability needed to meet the agency's aerospace mission and research requirements in the late 1980's and beyond. Initial emphasis will be placed on methods of improving sources of coherent radiation needed in the 9 to 30 micrometer range for remote sensing of the Earth and planetary atmospheres and faint astronomical sources

W81-70210 **506-54-45**
Jet Propulsion Laboratory Pasadena Calif
QUANTUM ELECTRONICS SOURCES
E D Hinkley 213-354-6586

The purpose of the electrophysics project is to perform basic research studies of the interaction of electromagnetic radiation with matter, develop new lasers for remote sensing applications, perform fundamental measurements to demonstrate remote-sensing potential and develop analytical techniques associated with such measurements. The following tasks are in support of these objectives: (1) demonstrate the feasibility of a small laser operating in the submillimeter region for remote sensing of species; (2) demonstrate feasibility of a diffraction radiation (DRG) free electron laser operating at submillimeter wavelengths; (3) demonstrate narrow-linewidth operation of present laser and evaluate remote-sensing applications potential; (4) study physical and chemical processes occurring in laser discharges with the objective of developing and improving UV/VIS gas lasers for active remote sensing applications; (5) measure cross sections for electron-atom, molecule and ion interaction pertinent to laser and plasma devices; (6) modify existing infrared laser system to measure atmospheric backscatter coefficients to a range of 20 km from laboratory and improve pulse rate; (7) develop and apply new mathematical methods for nonlinear systems; applications involve solitons, nonlinear and dispersive waves; and (8) study unstable dispersive waves

W81-70211 **506-54-46**
Goddard Space Flight Center Greenbelt Md
MULTI-SPECTRAL DETECTORS AND SENSORS
H W Price 301-344-8988
(506-61-36 506-18-16)

This RTOP consists of three tasks. The IR Heterodyne Spectroscopy task has as its objective the development of infrared heterodyne spectroscopy for exploration of non-thermal electromagnetic radiation lines at wavelengths greater than 15 microns. An infrared photomixer, laser local oscillator and spectral line receiver will be developed for this purpose. The purpose of the Tunable Submillimeter Local Oscillators Research task is threefold: (1) to improve the efficiency and power output of existing lasers using energy transfer and buffer gas techniques (approaches which utilize shifted CO₂ laser frequencies to enhance pumping efficiency will also be explored); (2) to produce new SMMW lasers and pump lasers (these would include Resonant Transfer Lasers in

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

the 12-20 micron range flash pumped gas lasers and 5 GHz tunable solid state lasers) (3) to tune the present laser emissions using intercavity phonon scattering in quartz. The Advanced Detector Research task has as its objective the development of advanced instruments and telescopes for use on Shuttle flights and new missions dedicated to observation and astronomical studies from both space and ground. This objective will be accomplished through advances in detector technology to obtain high resolution and low noise from large format imaging systems which operate in spectral ranges extending from soft X-ray through the ultraviolet and visible into the far red.

W81-70212 **506-54-55**

Jet Propulsion Laboratory Pasadena Calif

DATA TRANSMISSION AND PROCESSING RESEARCH

A R Johnston 213-354-4054

This RTOP consists of the following two areas. Fiber optic data transmission research in which the goal is to advance the technology of devices critical to fiber optics data transmission and processing for future NASA mission applications. The objectives are to develop a solid state picosecond pulse generator, evaluate the stability of precise time distribution by optical fiber and to investigate optical fiber transmitter and receiver design for data rates higher than 1 Gbits/sec and advanced optical techniques for real-time data processing which completes a study and demonstration of new optical techniques for processing two-dimensional data such as synthetic aperture radar data to be used for spacecraft and aircraft remote sensing systems. The most promising candidates for a system realizable in the next 2-3 years are spatial light modulators. There are two prime candidates for a two-dimensional spatial light modulator, the liquid crystal light valve (LCLV) and the Pockels readout optical modulator (PROM). A study being conducted this summer (FY80) at USC will determine which device is the most promising. That device will be chosen for the work to be performed under this RTOP. Wherever 'spatial light modulator' is mentioned in this RTOP there will be only one specific device actually being used.

W81-70213 **506-54-56**

Goddard Space Flight Center, Greenbelt Md

SIGNAL DETECTION AND PROCESSING FILTERS AND RECEIVERS

J F Arens 301-344-5758

This RTOP consists of two areas (A) tunable Fabry-Perot filters (TFBF) and (B) integrated acousto-optic spectrometer (IAOS) research. The intent of (A) is to develop a cryogenic TFBF with high finesse enabling the development of astronomical observing instruments with high resolving power in the midinfrared wavelength region. Several possible techniques for constructing these filters will be explored with special emphasis being given to a type of Fabry-Perot filter in which one plate of the interferometer levitates in a magnetic field generated by induced currents in a superconductor on the plate. A part of this proposed research would be directed at extending thin film deposition technology for interference coatings beyond its present range limit of about 15 micrometers to 20 micrometers into the 25 micrometers to 50 micrometers region. The objective of (B) is to develop wide bandwidth IAOS to be used as spectral line receivers in heterodyne spectrometers for space applications.

W81-70214 **506-54-59**

Marshall Space Flight Center, Huntsville Ala

SIGNAL PROCESSING AND DETECTION HIGH-DENSITY CIRCUIT TECHNOLOGY

J M Gould 205-453-3772

This effort provides comprehensive means to reduce design and fabrication cycle time and cost for large and very large scale integrated (LSI & VLSI) circuits, electronic subsystem packaging costs and screening and reliability testing costs. Developments include two level metal (TLM) post processing for existing LSI and developing VLSI technologies, layout software for TLM semicustom devices with 10 to the 6th transistors per sq cm, a TLM embodiment of the structured design approach as a 10 to the 7th transistors per chip full custom alternate design synthesis simulation, test pattern generation and validation.

software driven by high level language evolving towards hierarchical design, a low cost turn key design system, color and VLSI interactive graphics, a subsystem cost model to define cost effectiveness of custom integrated circuits, methods to interface with VLSI vendors by participation in the development of a VLSI process in which TLM circuits are created, epoxy lid sealing, repair and multiwire packaging techniques applied to existing flight hardware, multichip subassembly arrays procurement and application standards for plastic encapsulated integrated circuits, procedures for wafer testing and optical scanning, inspection criteria for improving the reliability of multilayer ceramic capacitors, operating procedures for X-ray topographic inspection of wafers and corrective actions for failure causes in VMOS power transistors.

W81-70215 **506-54-60**

National Aeronautics and Space Administration Washington D C

HIGH DENSITY CIRCUIT TECHNOLOGY ELECTRONIC DEVICES

Martin M Sokoloski 202-755-8503

The objective of this program is to provide effective coordination of NASA-sponsored research and development efforts on electronic devices and systems with similar work supported by DOD and other government agencies. Through associate membership on the Advisory Group on Electron Devices and its constituent working groups, NASA program managers receive expert advice on the feasibility, currency and soundness of planned R&D procurement activities, long ranging R&D requirements, complementary work in other government agencies and forecasts of new technical developments.

W81-70216 **506-54-63**

Langley Research Center Hampton Va

ADVANCED ELECTRONIC COMPONENTS

R L Stermer 804-827-3535

(506-20-23 506-18-13)

The objective is to develop advanced electronic devices and components for increased capability and cost efficiency of information handling. Additionally, novel device concepts are to be evaluated to enhance information acquisition in terrestrial observation and similar aerospace applications. A balanced approach between research contracts, grants and in-house research is used. Theoretical and experimental investigations of materials and device concepts will be conducted in-house. These studies provide a basis for a balanced contractual effort to develop those material and device technologies which have potential of improved performance and cost effective information handling.

W81-70217 **506-54-65**

Jet Propulsion Laboratory Pasadena Calif

FUNDAMENTAL ELECTRONICS

J Maserjian 213-354-3801

(506-25-75 506-61-35)

This RTOP consists of two tasks (A) Physics and Chemistry of Reliability. This task has as its objective research into cost-effective methods for overcoming major reliability problems limiting the implementation of large and very large scale integrated (LSI/VLSI) electronic circuits necessary for future space systems. Such problems, in part, are lack of long-life reliability susceptibility to radiation damage and lack of custom LSI/VLSI design capability. The approach to the reliability question for field-effect devices lies in the physics and chemistry of interfaces, the region between the semiconductor and the insulating layer which influences the device channel conductivity. To this end, electrical and interface/surface analytical techniques are developed to study various phenomena such as the correlations between chemical processing and device failure. Results will provide a base for computer-automated diagnostics on test chips on industrial LSI circuit fabrication lines. Custom LSI capabilities are being addressed by the development of a computer-based design system for use by all NASA Centers. (B) Advanced Solid-State Devices. This task has as its objective the development of advanced devices such as solid-state oscillators, multispectral sensors, detectors and mixers and superconducting devices for future space mission requirements. The approach is based on

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Investigations of new materials techniques and device structures e.g. the synthesis of new compound semiconductor microstructures by means of advanced ultra-highvacuum techniques such as molecular-beam epitaxy (MBE) with associated surface-analysis techniques. These efforts will impact advanced detector arrays submillimeter wave devices cryogenic semiconductor bolometers superconducting devices for improved far-IR spacetelescope detectors and improved pyroelectric broad-band IR detectors for long-term non-cryogenic operation

W81-70218 **506-54-69**
Marshall Space Flight Center Huntsville Ala
SOLID STATE RESEARCH SUPERCONDUCTING CIRCUITRY
P N Peters 205-453-5134
(188-41-54)

Existing facilities for thin film deposition microfabrication and cryogenic measurements are being utilized to investigate and develop sensors based on superconducting electronic properties. These devices will be compatible with flight experiments requiring cryogenically cooled surfaces. Single and arrayed Josephson junctions coupling techniques fundamental material properties superconducting quantum interference effects and sensor/photon interactions are being investigated and hybrid circuits operating at liquid helium temperatures are under consideration

W81-70219 **506-54-73**
Langley Research Center Hampton Va
AUTOMATED DECISION MAKING AND PROBLEM SOLVING
A J Meintel 804-827-2489
(506-54-83)

The objective of this research activity is to make available to NASA the complete range of generic automated problem solving techniques and advanced machine intelligence concepts. The long-range goal is to fill the technology gaps and provide those machine intelligence advances needed to allow the design development and utilization of advanced systems required for automated operations consistent with NASA's needs both in space and on Earth. The near term approach is to determine the state-of-the-art capability in automated decision making and to devise and institute mechanisms to make this capability available to appropriate areas within NASA and to institute grants and contracts that advance decision making technology. The long-range approach is to modify and advance these decision making algorithms and techniques through in-house research grants and contracts as required to fulfill NASA's special needs. The scope of the work will be expanded through a phased buildup to encompass a broad based machine intelligence research effort

W81-70220 **506-54-75**
Jet Propulsion Laboratory Pasadena Calif
AUTOMATION OF SPACE MISSION UPLINK PROCESS CONTROL

Terry D Linick 213-354-3161
(540-01-15 543-01-16 506-54-76 506-54-73)

The objective of this task is to identify and develop specific mechanisms for application to the uplink process control (often called sequencing) of space missions to significantly reduce its cost and to increase system responsiveness to user inputs. The uplink process control for recent deep space missions has been noted for very high costs and the time required to transform a request for an observation into an onboard activity has become quite large. Since a substantial part of the uplink process control has been manual-labor-intensive application of automation techniques has the potential for significant improvements with respect to cost and responsiveness. The approach consists of (1) examining current uplink process control architecture to discover where automation would be useful (2) analyzing appropriate automation technologies and (3) synthesizing the results of items (1) and (2) to determine where and how to automate uplink process control. The conclusions will address how automation can be immediately applied to uplink process control which technologies will have such applications in the future and will recommend the directions for development of

critical technologies which would make them more useful to uplink process control. The conclusions will address how automation can be immediately applied to uplink process control which technologies will have such applications in the future and will recommend the directions for development of critical technologies which would make them more useful to uplink process control. This RTOP was initiated as a result of developments in artificial intelligence at JPL and the continued development and application of artificial intelligence is considered a key ingredient in this task. Thus research into the ERIS technology previously covered by RTOP 506-19-35 (Robotics/Machine Intelligence) is continued. The study is oriented toward providing tangible benefits as rapidly as practical. While continuing to develop and identify base technologies. The refore the recommendation for near-term incorporation of automation techniques is scheduled for delivery in the third quarter of 1981. Recommendation for future directions for technology development will be completed by the end of FY-82

W81-70221 **506-54-76**
Goddard Space Flight Center Greenbelt Md
AUTONOMOUS PROCESS CONTROL TECHNOLOGY FOR EARTH ORBITAL MISSIONS
J L Maury 301-344-6683
(506-20-16 520-73-06 541-01-16)

This RTOP will provide and validate the advanced software/hardware tools and algorithms required for a dynamic automatic scheduling system (DASS). The scheduling of ground support services for Earth-orbital spacecraft currently relies on a labor-intensive primarily manual approach based on real-time priority assignments with relatively little optimizing capability and no direct knowledge of the load it imparts on the total processing system. The DASS as it is conceived will make more efficient use of this spacecraft support system and markedly decrease the work force now required in scheduling these systems. In addition DASS will be able to automatically schedule ground processing and data distribution and to accurately predict consequential load on ground processing data transmission and data storage through self-correcting system-activity models. Predicated on the optimized spacecraft service schedules DASS will also continually predict volume and content of space data output as well as its delivery schedule to users. Finally DASS will serve as a tool for examining the impact of changes (deletions or additions) in the constellation of satellites serviced by NASA. In the initial phase of this RTOP the DASS concept will be developed and refined. The second phase will be the identification of specific required software and the scheduling algorithms to be employed. The final phase will be the development of a prototype DASS model and experimental exercise of the system. This work will be coordinated with the OAST NEEDS Program and the OSTDS Advanced Systems Program

W81-70222 **506-54-83**
Langley Research Center Hampton Va
INTELLIGENT SYSTEMS RESEARCH
C T Wooley 804-827-3871
(506-54-73)

The research objective of this plan is to advance Intelligent Systems technology to enable the design development and utilization of advanced systems for future space robotics applications including space assembly space manufacturing and space servicing of satellites. To achieve these objectives the program focus will be to conceptualize investigate and verify algorithms sensors, actuators software and system architecture required for automated space operations. Specific near-term objectives are (1) development of a prototype multi-arm manipulator to be used for space assembly studies (2) development of high speed processing techniques and hardware for specialized algorithms such as numerical integration filtering and matrix manipulation and (3) development of multiple-arm coordination techniques and software

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70223 506-54-85

Jet Propulsion Laboratory Pasadena Calif

ROBOTICS/MACHINE INTELLIGENCE AUTOMATED SYSTEMS

Carl Ruoff 213-354-6101

(506-61-16 199-60-60 199-60-80 906-75-27 506-54-75)

The overall objective of this RTOP which supports the PASO objectives in Machine Intelligence and Robotics is to develop and demonstrate laboratory versions of sensing and control technologies for automated systems and robots. A specific objective is the development of a visual subsystem for control applications. In FY-81 work toward this objective will include (1) developing object models useful for tracking of three dimensional objects (2) developing stereo object recognition algorithms for simple objects in arbitrary poses (3) developing initial stereo tracking algorithms which work at one-half normal frame rates and (4) cooperating with NASA-Goddard on the use of the Massively Parallel Processor prototype in real-time scene analysis.

W81-70224 506-54-93

Langley Research Center Hampton Va

ADVANCED SPACECRAFT POINTING AND CONTROL SYSTEMS

J D Shaughnessy 804-827-3917

The objectives of this RTOP are the development of analysis tools conceptual design and hardware for precision pointing and control components and systems the development of long life cost effective navigation guidance and control systems concepts and the development of large space structures control and pointing technology. To achieve these goals new devices concepts and analyses are being pursued. These include (1) spacecraft attitude control momentum storage devices such as the magnetically suspended Annular Momentum Control Device (AMCD) (2) analytical studies of the stabilization and control of large space structures and (3) analytical studies of optimal maneuvering of large space structures. Through these efforts technology is being developed to permit the design and implementation of cost-effective spacecraft pointing and control systems. System and component requirements as well as conceptual designs are being defined through the use of analysis and simulation. Effective system configurations low-cost system integration multipurpose operation and component standardization will be used to reduce system and components costs while achieving required performance. Development of control and sensor hardware will be undertaken and critical hardware elements will be carried through laboratory evaluation to establish feasibility.

W81-70225 506-54-95

Jet Propulsion Laboratory Pasadena Calif

PRECISION POINTING AND CONTROL TECHNOLOGY (PPACT) DEVELOPMENT

S Z Szirmai 213-354-4431

The long range objective of this RTOP is to develop and verify innovative pointing and control technology for spacecraft control systems with emphasis on resource efficiency low cost and reduced weight and power on future planetary space vehicles. Specifically these objectives will be achieved through ground and on-board automation, improved resource/performance tradeoffs and control system architecture for multiple missions and versatile hardware inventory to support multiple mission capability. Additionally mission operation costs will be reduced. The principle RTOP tasks in FY-81 involve developments of the fiber optics rotation sensor (FORS) for long life and low drift performance optical measurement technology for enabling navigation to comet asteroid and other planetary missions and on-board model error estimation for control of vehicle dynamics. The objectives for FY-81 are to (1) complete integration and evaluation of the microprocessor and software with the all waveguide fiber optics gyro (2) complete the OMT demonstration system design and software and initiate system tests (3) demonstrate basic technology for on-board estimation of dynamical errors due to wobble and nutation in a representative flexible spacecraft. The approach used to achieve these objectives will be to (1a) evaluate FORS waveguide component performance parameters (1b) integrate waveguide components microproces-

sor software and drive electronics into the FORS 2 design and complete modulated performance tests (2a) evaluate CCD sensor centerfinding algorithms applicable to on-board measurement extraction (2b) develop and demonstrate on-board data extraction and compression software (2c) initiate evaluation of the demonstration camera system in the OMT laboratory facility (3a) determine the model errors inherent in the Galileo attitude estimator design (3b) determine types of on-board data required to achieve model error estimation (3c) develop estimator designs capable of on-board detection of spacecraft dynamics and evaluate performance through computer simulation.

Space Power and Electric Propulsion Research and Technology

W81-70226 506-55-12

Lewis Research Center Cleveland Ohio

ADVANCED ENERGETICS

Thomas H Cochran 216-433-6897

(506-55-72)

The objective of this effort is to investigate advanced concepts in energy processing for space applications. The energy processing elements include the areas of (1) sources (2) conversion techniques and devices, (3) storage and (4) transmission or distribution systems and components. Concepts to be investigated in this program are those considered to be high risk and innovative but if successfully developed could provide substantial performance improvements for space missions beyond the 1990's. Advanced energetics will be identified by literature search and communication with leading researchers. The concepts will be assessed by in-house and contracted studies and analysis. Experiments and theoretical efforts will be conducted on key technologies to demonstrate concept feasibility. Selections will be made from among the competing concepts for follow-on system testing.

W81-70227 506-55-13

Langley Research Center Hampton Va

ADVANCED RADIANT ENERGY CONVERSION

F Hohl 804-827-3781

The objective is to conduct basic research on and to evaluate advanced concepts for the generation transmission and conversion of energy in space. Research will be performed to characterize radiation-induced plasmas leading to efficient high-power conversion of concentrated solar and nuclear energy directly into electromagnetic radiation laser power or work. Radiation-induced plasmas will be studied to determine population inversion nonequilibrium emission and ionization and excitation cross sections. The possibility of new lasers in the ultraviolet and visible region with greatly increased power output will be studied. Studies for the selection of the most promising lasing medium and transitions will be performed for direct solar excitation. Nuclear-pumped laser tests will be completed during fiscal year 1981 by using the U.S. Army Pulse Radiation Facility at Aberdeen Maryland and other reactors. Intense broadband UV and visible photon sources in operation and under development at LaRC will be used to experimentally investigate broadband pumped chemically reversible lasers and plasma heating. Efficient methods of converting broadband and monochromatic photon energy directly to electricity and storable hydrogen and oxygen by photochemical conversion will be developed. The RTOP has sufficient flexibility to take advantage of unique opportunities and concepts to advance space energetics research. Various grants and contracts will be used to perform supporting research under this RTOP.

W81-70228 506-55-15

Jet Propulsion Laboratory Pasadena Calif

ADVANCED ENERGY TECHNOLOGY

E Y Pawlik 213-354-3455

(506-23-15)

The objective of this RTOP is to identify and evaluate and if justified recommend for additional OAST funding innovative

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

advanced concepts in the areas of energy collection conversion transmission and storage which show promise to enable or significantly enhance future space missions In cooperation with Lewis Research Center new and existing concepts will be evaluated This evaluation will systematically address the basic feasibility of the concept problem areas and potential value when developed This work is necessary to provide the fundamental understanding required to advance our capability to explore and use the extraterrestrial environment The highest ranking concepts will be subject to a more detailed assessment This assessment might include systems studies analytical modeling and/or test evaluation of experimental hardware The results of these detailed assessments will be evaluated and concepts of outstanding or potential merit will be recommended for separate funding by OAST The specific concepts to be investigated in FY-81 are (1) advanced energy storage systems, (2) MHD energy conversion and (3) alkaline metal thermoelectric converter Additional categories in which concepts may be considered are spacecraft tether power generation advanced photovoltaic concepts advanced heat rejection and advanced optics for solar energy conversion

W81-70229 **506-55-19**

Marshall Space Flight Center Huntsville Ala
LASER PROPULSION

R J Richmond 205-453-3710

A technology base for laser propulsion is being developed Laser radiation absorption experiments using pure hydrogen seeded hydrogen and other propellant gases will be conducted Experimental results will be compared with analytical predictions and generalized thruster design model developed Parametric analyses of thrusters using various propellants will be conducted The more promising configurations will be selected for further analyses and finally one configuration will be selected for fabrication and testing

W81-70230 **506-55-22**

Lewis Research Center Cleveland Ohio
ELECTRIC PROPULSION TECHNOLOGY

R C Finke 216-433-6119

The overall program objective is to identify and develop the technology for future electric propulsion systems for application to planetary and Earth orbital missions Technology for auxiliary electric propulsion systems will be identified and developed for stationkeeping and attitude control of geosynchronous spacecraft and future large space systems Tests and analyses will be performed to verify the lifetime of the baseline 30cm mercury ion thruster and fully characterize its interfaces and this information will be transferred to the user community An extended performance program is directed toward improving the performance of the 30cm mercury thruster system in order to enable new planetary mission capability The advanced primary propulsion technology program will define and develop primary electric propulsion technology to enhance the performance and reduce the cost of Earth orbital missions Promising technology concepts will be defined by analyses study and by basic research activities Focused technology activities will be performed in order to characterize the performance and interfaces of critical elements of electric thruster systems, such as thrusters and power processors Tests and analyses of the critical system elements will then be performed to assure element interface compatibility and evaluate their lifetime and performance Work will be performed both by in-house and contracted efforts

W81-70231 **506-55-32**

Lewis Research Center Cleveland Ohio
ION THRUSTER RESEARCH AND ION BEAM APPLICATIONS

R C Finke 216-433-6119

The aim of this RTOP is to obtain an understanding of the physical processes inherent in electric propulsion systems investigate concepts to improve the performance reliability and durability of ion thrusters conceive and investigate advanced electric propulsion concepts and enable the development of new or improved materials processes and products through non-propulsive application of ion thruster technology

W81-70232

506-55-35

Jet Propulsion Laboratory, Pasadena Calif

MPD THRUSTER SYSTEM TECHNOLOGY

L K Rudolph 213-354-3478

(506-55-15 506-55-65 506-55-75)

The objective of this RTOP is to pursue research into the controlling physical processes involved in electric propulsion, to evaluate advanced concepts such as the magnetoplasma-dynamic (MPD) accelerator and to investigate the nonpropulsive applications of electric propulsion technology The FY-81 objective is to complete the preliminary technology development and evaluation of the MPD accelerator With successful demonstration of this technology, efforts can then proceed with thruster development Specifically, this effort establishes the fundamental viability of the magnetoplasmadynamic thruster by demonstrating that the problems limiting performance and lifetime can be resolved The approach will be to (1) evaluate the technology associated with operating quasi-steady state MPD thrusters with pulsed energy transfer systems (2) define the potential performance, efficiency and lifetime of the MPD thrusters (3) conduct a preliminary conceptual study of how an MPD thruster might be incorporated into either solar electric propulsion or a nuclear electric propulsion vehicle and (4) provide basic understanding of the physical processes involved in electric thrusters and the application of this technology to plasmodynamic lasers Specific thruster performance goals for this program include thrust densities over 10 to the third power N/M(2), exhaust velocities between 20 and 100 km/sec thrust efficiencies over 50 percent and a lifetime commensurate with projected applications including deep space exploration

W81-70233

506-55-42

Lewis Research Center Cleveland Ohio

SOLAR CELL TECHNOLOGY

H W Brandhorst 216-433-4000

The objective of this RTOP is to improve conversion efficiency as well as reduce mass reduce cost and increase operating life of solar cells and blankets Research and technology programs will be continued in the following areas radiation damage mechanisms in silicon solar cells high efficiency silicon solar cells very thin cells with coplanar back contacts and reduced absorptivity processes for fabricating cells at low cost thin flexible encapsulants and modules gallium arsenide solar cells and substrates and concepts with the potential for 30% and 50% solar energy conversion

W81-70234

506-55-43

Langley Research Center Hampton Va

SOLAR CELL RESEARCH

E J Conway 804-827-3781

This basic research program is broadly oriented toward developing the technology to improve conversion efficiency reduce mass reduce cost and increase the operating life of GaAlAs/GaAs solar cells The R & D to achieve high efficiency (18 to 20 percent in space) GaAlAs/GaAs solar cells with high temperature (200 to 300 C) operating capability low weight and long life in a radiation environment is being performed for potential space applications, such as long duration solar electric propulsion (SEP) a space power station or a near Sun mission This program emphasizes the effects of proton irradiation on cells and cell materials optimization of the structure to maximize radiation stability and annealing to heal radiation damage The long-term stability of cells and contacts at 200 C is studied to support concentrator and continuous annealing modes of operation A third research emphasis involves thin crystal p-n junction cells for high power to weight ratio space cells Liquid phase and chemical vapor deposition epitaxial growth techniques are employed to develop improved cells In addition the program generates cell concepts and techniques through funding and encouragement of universities and industries If there are unique or novel opportunities that arise funds and manpower will be shifted to address these areas

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70235 **506-55-45**

Jet Propulsion Laboratory Pasadena Calif

PLANETARY SOLAR ARRAY RESEARCH AND TECHNOLOGY

Walter A Hasbach 213-354-6132

The primary objective of this RTOP is to develop the technology necessary to increase interplanetary and geosynchronous planar array power-to-mass performance through improvements in blanket efficiency, blanket mass, and solar array structural mass. The goal is to increase the specific power of a 12.5 kW array from 66 W/kg to 240 W/kg by increasing the blanket efficiency from 7 percent to 10 percent and reducing both the blanket mass and structural mass by 60 percent from the current values of 9.4 kg/kW and 5.8 kg/kW. Blanket specific power will thereby be increased from 106 W/kg to 350 W/kg. A second objective of this RTOP is to develop low mass concentrator arrays for use on geosynchronous and interplanetary missions. A last objective is to assist NASA in evaluating the performance, applicability, and radiation susceptibility of newly designed solar cells. The following tasks support the above objectives and targets of the FY-81 PASO: (1) develop for flight qualification testing a > 250 W/kg blanket consisting of OAST thin silicon solar cells. Demonstrate and advanced blanket concept capable of > 350 W/kg employing second generation OAST thin cells; (2) develop new low mass structure and deployment concepts for advanced planar and concentrator enhanced photovoltaic arrays. As a goal this technology should be capable of 240 W/kg at operating temperatures in GEO and > 10 W/kg at 6 angstrom units (Jupiter); (3) test and evaluate cell technology developed by the Department of Energy for applicability to space power needs; (4) publish an update of the Solar Cell Radiation Handbook; and (5) develop a technology for fabricating epitaxial GaAs on single crystal Si substrates with solar cell efficiencies of at least 16% (AM0) and having less than 10% efficiency loss after an equivalent 10-years radiation exposure in synchronous orbit.

W81-70236 **506-55-52**

Lewis Research Center Cleveland Ohio

ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE

Lawrence H Thaller 216-433-4000

The objective of this program is to attain long life, high energy density, high reliability and lower cost of electrochemical energy storage and conversion devices. The emphasis is on metal-gas and alkaline component technology, high energy density batteries and multikilowatt hour storage technology which includes H₂-O₂ alkaline fuel cells to operate with long endurance and higher efficiency. During FY-81 the development of crosslinked polymeric separators for alkaline and high energy batteries will continue. The > 200 Whr/kg chalcogenide positive-sodium negative cell will be characterized. Work on new polymeric separator materials for high energy non-aqueous lithium cells will continue. An optimum Ni/Cd cell design for rapid deep discharge-reconditioning will be completed. Technology of very high capacity long life batteries and fuel cell electrolyzer systems will continue with added emphasis on Ni/H₂ cells. The 100 Ahr toroidal Ni/Cd cell feasibility will be completed. The evaluation of alkaline electrolysis oxygen electrocatalyst will continue testing at higher pressures and the single cell technology optimization toward longer life will be pursued.

W81-70237 **506-55-55**

Jet Propulsion Laboratory Pasadena Calif

ADVANCED NICKEL-CADMIUM AND LITHIUM BATTERIES

I Stein 213-354-6048
(506-23-22)

This RTOP supports the PASO specific objectives to achieve improved performance, energy density and lifetime as well as to extend the operational capability of space batteries for interplanetary and Earth-orbital missions. The effort involves three tasks: (1) An improved set of processing and test specifications will be formulated to achieve a ten year life battery. A major FY-81 objective is to complete the nondestructive evaluation techniques for application to cell-life predictions. The approach

is to obtain a fundamental understanding of the mechanisms of failure and degradation modes by applying both destructive and nondestructive evaluation methods and accelerated test techniques. (2) Safe and reliable primary lithium batteries with higher energy density (greater than 300 Whr/kg) and longer life (greater than 5 years) than existing primary batteries for future NASA missions will be developed. A major FY-81 objective is to identify key controllable factors that will permit cells to be 100% safe. The approach involves two parallel efforts: a basic research effort to identify improved cell materials or technology and a developmental effort to incorporate and evaluate these new materials and technologies in practical cells and subsequently in prototype batteries. Secondary lithium batteries will be developed with an energy density of 200 Whr/kg and greater than 5 year lifetime. A major FY-81 objective is to determine key processes/reactions that limit performance. The approach is to achieve a fundamental understanding of the electrochemical processes which govern performance. A materials and electrode processes research effort to improve the anode, cathode and electrolyte in the cell will be incorporated in a developmental prototype cell effort.

W81-70238

506-55-57

Lyndon B Johnson Space Center Houston Tex

ORBITAL ENERGY STORAGE AND POWER SYSTEMS (H₂/O₂)

Hoyle McBryar 713-483-6128

The objective of this research effort is to advance fuel cell and electrolysis cell technology to maturity and to demonstrate suitability to large orbital energy conversion and storage requirements of high power and long life. A data base will be developed at the cell and component level. This will provide the basis for design of the larger developmental test articles. An interim test will be conducted on breadboard type hardware of about 5-7 kW in the integrated mode. This will serve as a testbed to help define technology limitations and to evaluate interaction phenomena of dissimilar fuel cell/electrolysis cell concepts. Engineering model hardware will be fabricated which incorporates all technology advances for field demonstration technology readiness. The results will provide a basis for selection of the regenerative Fuel Cell over other potential concepts for large orbital energy storage systems.

W81-70239

506-55-65

Jet Propulsion Laboratory Pasadena Calif

THERMAL-ELECTRIC AND THERMIONIC ENERGY CONVERSION TECHNOLOGY

Jack F Mondt 213-354-6847

The overall objective is to develop thermal-to-electric energy conversion technology to provide electrical power for propulsion and science as required to explore our solar system and its surroundings. Desirable characteristics of such a power system are: low weight, low volume, long life, high reliability, power level flexibility, minimum integration complexity, maximum safety and low cost. The enabling technology is divided into four tasks: (1) NEP System Technology. A power subsystem design which is compatible with the mission requirements will be provided. The critical conversion technologies to be developed will be delineated and interface technologies between the energy conversion device and the heat source and heat rejection subsystem will be developed. (2) NEP Conversion Technology. Thermionic converter concepts will be tested to demonstrate high efficiency and high power density. Thermoelectric materials which exhibit high efficiency, high power density and high operating temperature capabilities will be tested and evaluated to demonstrate technology readiness. Analytical evaluation of the Brayton cycle conversion technology configured for space power will be continued. (3) RTG Technology. New advanced thermoelectric materials which theoretically will provide a reliable, efficient and cost effective conversion system and is compatible with existing radioisotope heat sources are investigated under this task. The advanced materials are fabricated and tested at temperature to determine their thermoelectric properties. (4) STG Technology. A solar thermoelectric technology capable of surviving the environments of near-Sun missions is being evaluated. Selected generator concepts will be designed and tested.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

to demonstrate technology readiness. A Resident Research Associate (RRA) is supported by this RTOP

W81-70240 **506-55-72**

Lewis Research Center, Cleveland Ohio

POWER SYSTEMS MANAGEMENT AND DISTRIBUTION

R C Finke 216-433-6119

The objective is to provide the technology base for multi-kW space power systems and subsystems including power interface energy storage electrical components circuit concepts environmental interactions with space plasma, power processing transmission and distribution needed for semipermanent low earth and geosynchronous power systems in the mid 1980's to mid 1990's. The proposed work will define and develop the technology necessary to both extend shuttle capabilities and establish central utility power capabilities essential to the habitation and development of near Earth space. In house and contractor studies will be conducted to determine performance requirements identify system constraints estimated cost weight and size of potential space power systems identify new technology needs and determine benefit/cost ratio of proposed technology programs. Contractor/in house analysis and experimentation will be used to define develop and test components circuit concepts subsystems and systems. Investigations will be conducted to evaluate interactions between the space plasma environment and spacecraft surfaces at various voltages. Design guidelines for controlling these interactions will be issued. A strong activity will be maintained to coordinate with and support work at other NASA centers

W81-70241 **506-55-75**

Jet Propulsion Laboratory Pasadena Calif

PLANETARY POWER SYSTEMS RESEARCH AND TECHNOLOGY

Arthur O Bridgeforth 213-354-5626

The two tasks in this RTOP support the FY-81 PASO specific objective to provide the technology base necessary to control the generation and distribution of energy in future space systems and to assure their environmental compatibility. Future planetary exploration missions will result in long round trip communication time and large variations in power system operating parameters preventing the proper management of these power systems through conventional Earth-based monitoring and command functions. The objective of the first task is to develop the capability of a spacecraft power system to automatically perform monitoring computational and control functions without the need for ground intervention. An existing breadboard power system has been modified to incorporate selected APSM functions to demonstrate technology feasibility. The performance of this system will be evaluated and a final report prepared by the end of FY-81. A technology feasibility demonstration of the APSM/V075 Breadboard system will be conducted in the third quarter of FY-81. The objective of the second task is to develop the technology for controlling spacecraft system interactions with the charged particle environment of space. This activity is a portion of a joint AF/NASA comprehensive research and technology program on spacecraft environment interactions. This technology will be required to provide design information for both large spacecraft missions and high power modules

W81-70242 **506-55-76**

Goddard Space Flight Center Greenbelt Md

ADVANCED POWER SYSTEM TECHNOLOGY

L W Slifer 301-344-8841

The basic objective for this RTOP is to convert power technology Research and Development accomplishments at the various NASA centers and DOD agencies to a state of readiness for future flight applications. The approach includes the overall assessment of Research and Development status, the evaluation of technology advancements in terms of potential for flight application the completion of engineering development necessary to bring high potential advancements to technology readiness, and analysis of power systems incorporating the advanced technology. The RTOP consists of four tasks (1) power technology assessment (2) analytical modeling of power systems (3) assessment of nickel-hydrogen batteries and (4) assessment of flywheel energy storage

W81-70243

506-55-79

Marshall Space Flight Center Huntsville Ala

MULTI-KW LOW COST EARTH ORBITAL SYSTEMS

J R Graves 205-453-2514

(506-55-49)

The objectives of this RTOP are to provide the technology and capability within NASA to process distribute and control electrical power in multi-100 kW type systems and to reduce space energy costs through improved efficiency life reliability and maintenance. These objectives will be accomplished via a combination of in-house and contracted efforts and will consist of the following tasks (1) establish component and subsystem requirements sizes frequencies voltages and sensitivities, and rank critical technologies consistent with overall system development (2) design and develop the necessary power processing/conditioning circuitry for high voltage multi-kW power systems (3) develop utility type power management and control techniques for spacepower systems (4) construct a system breadboard for evaluation and demonstration of new technologies and power management and control techniques

Multidisciplinary Research

W81-70244

506-56-11

Ames Research Center Moffett Field Calif

FUNDS FOR INDEPENDENT RESEARCH (SPACE)

G T Chapman 415-965-5654

(505-36-11)

Innovative and discretionary basic research in areas related to space are supported by this RTOP. The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA's requirements in space including the technical fields of lasers energetics materials, applied mathematics superconductivity chemistry and physics. The OAST Research Council and the Ames Funds for Independent Research (FIR) Committee review unsolicited proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs. Those research proposals that are judged by the Council and FIR Committee to be worthy of support on a scientific or engineering basis are selected as candidates for funding

W81-70245

506-56-12

Lewis Research Center Cleveland Ohio

FUND FOR INDEPENDENT RESEARCH (SPACE)

Marvin E Goldstein 216-433-4000

The objective is to support innovative long range, high risk basic research in areas related to space. The program pursues basic investigations of technologies in fundamental science and engineering needed to satisfy NASA's requirements in space including the technical fields of lasers energetics and energy conversion materials science applied mathematics superconductivity chemistry and physics. Members of the Lewis Research Advisory Board at the request of the Chief Scientist review unsolicited research proposals that have been judged to be worthy on scientific or engineering grounds but have not been selected for support because of their long range or high risk nature or because of funding limitations in the other specific discipline programs. Those research proposals that are judged by the Board to be worthy of support on a scientific or engineering basis are selected as candidates for funding. These proposals are then prioritized by the Chief Scientist and funded to the extent permitted by available resources. The Chairman of the OAST Research Council is kept informed of funding plans to prevent duplication and to provide coordination. Progress and results are reported periodically by the grant monitor and submitted to the Chief Scientist for review and for distribution to OAST Research Council

W81-70246

506-56-13

Langley Research Center, Hampton Va

FUND FOR INDEPENDENT RESEARCH (SPACE)

W D Erickson 804-827-2471

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

The objective of this plan is to support basic research in universities in areas related to space through the funding of a limited number of unsolicited research proposals from various universities. University research proposals that have been judged to be well worth supporting on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs are considered. University research proposals that have been evaluated and are not funded through any of the research programs are reviewed by the Langley University Research Proposal Review Committee. Those research proposals that are judged by this committee to be well worth supporting on a scientific or engineering basis are selected as candidates for funding through this plan. The committee establishes a priority listing of these proposals and selects those efforts that are judged to be the more innovative and aimed at the longer term research of potential relevance to future NASA space programs.

W81-70247 **506-56-16**
Goddard Space Flight Center Greenbelt Md
FUND FOR INDEPENDENT RESEARCH
T Kostiu 301-344-8431

The objective is to conduct basic research in the field of remote detection spectroscopy and imaging in the middle infrared using infrared to visible upconversion techniques. The program pursues a basic investigation of new technology in fundamental science and engineering needed to satisfy NASA requirements in space specifically the development of laser technology and laser systems applicable to highly sensitive infrared detection of atmospheric astronomical and astrophysical sources. The approach is to theoretically optimize the design and performance characteristics of intra-cavity upconversion systems construct such systems and experimentally verify theoretical predictions investigate the physics involved analyze and test the application of these systems to astrophysical observations.

W81-70248 **506-56-19**
Marshall Space Flight Center Huntsville Ala
FUND FOR INDEPENDENT RESEARCH
R Decher 205-453-5130

The objective of this RTOP is basic research related to NASA's goals of space flight and space research. Work covered by this RTOP includes experimental and theoretical studies of more fundamental problems connected with scientific flight experiments advanced scientific instrumentation and advanced technology.

W81-70249 **506-56-29**
Marshall Space Flight Center Huntsville Ala
UTILIZATION OF SPACE FOR SCIENCE EXPERIMENTS
George H Fichtl 205-453-0875

The objective of this RTOP is to perform basic research in the areas of fluid mechanics and gravitational physics with a view toward developing experiments which require the unique characteristics of space for their successful accomplishment. This research is motivated by the need to resolve fundamental scientific problems and issues which are of significant importance in the areas of pure and applied physics and which relate to national needs. The approach for accomplishing this basic research involves a combination of analytical and ground-based experimental efforts. The work will be phased according to the requirements of the Physics and Chemistry Experiments (PACE) in Space Committee. The effort involves two tasks namely Task 01 - Gravitational Physics and Task 02 - Fluid Mechanics.

Information Systems Research and Technology

W81-70250 **506-61-22**
Lewis Research Center Cleveland Ohio
HIGH EFFICIENCY TECHNOLOGY FOR MICROWAVE AMPLIFIERS
R E Alexovich 216-433-6689
(506-54-42 541-02-12 650-60-22)

The objective of this RTOP is to provide through research design data and tests the technology base for development of high efficiency high power microwave amplifiers for space and airborne applications capable of real-time handling of data in space and state-of-the-art jamming power in ECM systems. To achieve this, objective research and technology development programs will be undertaken on several types of microwave amplifiers applicable to high efficiency requirements from 1 to 100 GHz. Specific techniques such as multistage depressed collectors and spent beam refocusing and development of methods for high efficiency performance in the linear low distortion region will be pursued. Investigation of low loss high efficiency circuits will be continued.

W81-70251 **506-61-25**
Jet Propulsion Laboratory Pasadena Calif
HIGH SPEED DATA TRANSFER X/S BAND COMPONENTS

James F Boreham 213-354-4107

The general objectives of this RTOP are to develop microwave subsystems and techniques which (1) increase data transfer by a factor of 10 to 100 (2) improve radio navigation accuracy by factors of 10 to 100 (3) improve carrier tracking stability by two orders of magnitude (4) improve communications component reliability by a factor of two and (5) reduce cost and weight of these components by at least one third. The development phases for the flight equipment for an X-band uplink capability will be to develop a down converter to interface with a NASA Standard Deep Space Transponder with a flight experiment demonstration on ISPM and develop an integrated X-band transponder with wide band ranging improved phase and group delay stability and adaptability to dual frequency operation as a long term solution for the late 1980's and beyond. Development phases for the X-band Solid State Power MPLIFIers (XEEPA's) will be to develop 10 to 40 watt XSSPA's with overall DC to RF efficiencies of approximately 30% as replacements for the expensive and relatively unreliable TWTA's and using technologies developed for the XSSPA's and the Array Feed Power Amplifiers (FY-78 79) combined with phase shifter and controller technologies develop vernier Electronic Beam Steering Flight and ground system trade off studies will be performed to determine the most cost effective weight efficient and low risk means of achieving the greater telecommunications performances needed for future deep space missions. Two flight experiments will demonstrate basic features of the X-band transponder. These include (1) a wideband one way delta VLBI ranging capability for the Galileo mission providing improved navigation accuracy at low declination angles and (2) in conjunction with OSIDS RTOP 310-20-64 a phase stable X-band uplink capability for ISPM to permit the search for gravity waves.

W81-70252 **506-61-26**
Goddard Space Flight Center Greenbelt Md
HIGH SPEED DATA TRANSFER, S/K-BAND COMPONENTS AND TECHNIQUES

Dominick E Santarpia 301-344-6375

The objective of the work to be accomplished under this RTOP is the advancement of spacecraft technology in tracking data generation and data transfer to satisfy the communications requirements of future flight programs. The flight programs of the late 1980's and early 1990's are characterized by high data rates simultaneous multiple-links and reliable long life operation. The accommodation of such requirements shall be achieved through technological advances in spacecraft RF/microwave techniques and components.

W81-70253 **506-61-31**
Ames Research Center Moffett Field Calif
INFRARED DETECTORS FAR IR SENSORS
C R McCreight 415-965-6525
(358-41-06 188-41-55 506-61-41 506-61-43)

The objective of this RTOP is to develop advanced infrared detection systems for astronomical research. This program will provide the technology for new and more efficient data acquisition capability throughout the infrared (IR) spectrum (2-120 micron) for the low-background astronomical application. It will benefit

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

the entire NASA IR astronomy program including future programs such as the Shuttle Infrared Telescope Facility (SIRTF) and the Space Telescope (ST) and the on-going ground-based airborne, and balloon-borne programs. Activities will include development of hybrid and monolithic arrays of high-sensitivity extrinsic and intrinsic detectors and improved discrete components for ultimate array applications. IR array expertise developed by the Department of Defense (DoD) and NASA will be used for wavelengths below 30 micron. New IR arrays will be developed for wavelengths beyond 30 micron. Activities will also include development of real-time data preprocessing/data compression electronics for use with the arrays in the astronomical application. IR detector expertise in industry will largely be used for design, fabrication and preliminary testing of the arrays. Detailed evaluation of the arrays and electronics will be carried out at Ames and also at university facilities by interested IR astronomers. Realistic observational testing will be conducted using existing ground-based and airborne facilities. All work performed under this RTOP will be closely coordinated with related DoD and NASA activities.

W81-70254 506-61-33

Langley Research Center Hampton, Va
SENSOR SYSTEMS TECHNOLOGY

S L Ocheltree 804-827-2791

The objective of this research is to develop and evaluate advanced concepts for infrared ultrasensitive detectors, laser and electro-optic systems, and broadband microwave precision radiometers. Principal thrusts are to (1) develop, using CCD technology, monolithic detector arrays (1.5 and 2-30 microns), high quantum efficiency multi-GHz bandwidth photomixers and calibration-compensate techniques for multispectral scanners (2) investigate laser backscatter and fluorescence techniques for marine water parameter measurement and investigate continuously tunable infrared laser techniques for high resolution absorption and emission spectroscopy and measurement of low concentration atmospheric constituents (3) develop improved radiometer performance resolution, stability, bandwidth, and reliability through low-loss front end components, broadband devices with flat frequency response and microwave integrated circuit devices. Critical technology for a laser heterodyne spectrometer Spacelab instrument will be developed. Laboratory breadboard and aircraft testing will be used to demonstrate critical portions of the technology developed effort.

W81-70255 506-61-35

Jet Propulsion Laboratory Pasadena Calif
REMOTE SENSING SYSTEMS

Joh Wellman 213-354-7222
(506-18-35 506-54-45 198-10-06)

The objective of this RTOP is to develop and flight test advanced remote sensors (sources and detectors) for terrestrial atmospheric observations from Earth orbit, for astronomical observations from aircraft and Earth orbit for missions to other planets and comets and for supporting laboratory spectroscopy. The first element infrared detector array development consists of four interrelated activities to develop infrared array instrument systems (1) requirements definition, (2) technology development, (3) experimental evaluation and (4) field demonstration. The second element high resolution lasers techniques for ultraviolet-visible laser remote sensing is directed toward a demonstration of the unique capabilities of an active ultraviolet laser system to measure concentrations of trace atmospheric species from airborne and spaceborne platforms. This demonstration phase follows the successful development of an appropriate excimer laser in a task funded separately by the Electronic branch of OAST. The third element development of submillimeter wavelength components addresses four major component areas in submillimeter technology (1) development of efficient quasi-optical techniques for receiver front ends (2) development of techniques for efficient coupling of radiation to nonlinear devices (3) development of appropriate efficient nonlinear submillimeter devices and (4) development of local oscillator sources for the submillimeter region. This is a relatively new technology for which low-noise sensors operating at frequencies up to 2000 GHz (wavelengths shorter than 0.15 mm) are urgently needed.

W81-70256

506-61-36

Goddard Space Flight Center Greenbelt Md
SENSOR SYSTEMS

J J Degnan 301-344-7714

The objective of this RTOP is to develop and flight-test advanced sensors in support of NASA programs in geophysics, astronomy, atmospheric chemistry, climatology, topography, oceanography and earth resources. The sensors being investigated are both active and passive and span the near ultraviolet through microwave regions of the electromagnetic spectrum. The RTOP is subdivided into three principal elements. The first element, entitled High Resolution Lasers, encompasses the sensor systems which use lasers either as probes in active lidar systems or as local oscillators in passive heterodyne radiometers. Systems under development include a centimeter resolution laser ranging/altimetry system, a CO₂ differential absorption lidar, a tunable dye lidar and a passive submillimeter wave heterodyne radiometer. The second element, entitled 'Infrared Linear Detector Array Development' is directed toward the development of passive multispectral linear array instruments which operate primarily in the 1.4 and 8-12 micrometer spectral regions of the near infrared. This includes the development of pushbroom mode sensor systems and appropriate arrays and all-reflective optical systems for operation in the infrared. The objective of the third element, entitled 'Multifunction Microwaves', is to develop the advanced technology and system concepts for active and passive microwave and millimeter wave sensing of the earth's environment in selected bands from 0.6 to 225 GHz. Major tasks within this element include development of improved millimeter wave radiometer system components such as mixers, oscillators, filters and antennas and advanced multichannel active and passive microwave imaging systems.

W81-70257

506-61-37

Lyndon B Johnson Space Center Houston Tex
ADVANCED SYNTHETIC APERTURE RADAR TECHNOLOGY

K Krishen 713-483-2846

The day/night all-weather high resolution features of synthetic aperture radars provide an applications tool not available with any other remote sensor. The present state-of-the-art capabilities of spaceborne imaging radars include single-frequency, single polarization and swath-widths up to 100 km. The objective of the Advanced Synthetic Aperture Radar (ASAR) Project is to develop and demonstrate technology for SAR systems with new functional and performance capabilities for missions planned for 1985-1995 period. Specifically, the ASAR goals include wide-swath selectable frequency of the transmitter, selectable polarization and bandwidth, precise amplitude calibration to 0.5 dB. The immediate objective of the ASAR will be to demonstrate the technology for a multimode SAR capable of generating wide-swath at four frequencies and all linear polarizations. Long antenna (beam shaping) and electronic scanning techniques will be investigated for wide-swath implementation. The system technology will be demonstrated by acquiring data with an end-to-end system from an aircraft. The goal of the system design will be such that it is scalable for space use. Areas not addressed in the initial design/development such as elevation imaging will be identified and prioritized for future development.

W81-70258

506-61-43

Langley Research Center Hampton Va
INSTRUMENT POINTING SYSTEMS

C R Keckler 804-827-3917

The objectives of this RTOP are to develop and demonstrate techniques and systems capable of providing high accuracy pointing and stability (approximately 0.01 arcseconds) for experiments dedicated to stellar, solar and terrestrial observations as well as interplanetary investigations. To achieve these goals, new concepts, devices and analyses are being pursued. These include the development of techniques and systems for Earth-feature identification, acquisition and tracking as exemplified by the Video Landmark Acquisition and Tracking (VLAT) system and new approaches to high accuracy pointing and stabilization of an experiment through the use of the Annular Suspension and Pointing System (ASPS) which utilizes magnetic suspension.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Through these efforts technology is being established to permit the achievement of mission objectives during the Shuttle era in a cost-effective manner. Systems and components are developed and tested and system performance in orbit predicted through simulations. Effective system configurations, low-cost system integration, multipurpose operation and utilization will be used to reduce systems costs while achieving required performance. Development of control software and hardware will be pursued and evaluated in the laboratory prior to their flight verification onboard the STS. These efforts are being directly coordinated with GSPC, JSC, MSFC and JPL.

W81-70259 **506-61-46**

Goddard Space Flight Center Greenbelt, Md
SENSOR COOLING SYSTEM

Allan Sherman 301-344-5405

The overall objective of the cryogenics program is to provide low temperature technology which will be applicable to the large number of future missions that will require instrument cryogenic cooling. The program to accomplish these objectives includes technology development in the areas of mechanical coolers and solid cryogen coolers. The approach for the mechanical cooler R&T program is (1) develop 3 to 5 year 65 K lifetime cooler technology and prototype models utilizing a linear drive and noncontacting bearings and seals and (2) extend the 3 to 5 year technology to the development of a 12 K mechanical cooler. The objectives of the solid cryogen program are (1) lifetime/capacity enhancement for a given size (2) temperature range extension down to 8 K and (3) wider range of application for a given cooler system design. The program approach includes technology demonstration tests and systems development.

W81-70260 **506-61-53**

Langley Research Center Hampton, Va
NASA END-TO-END DATA SYSTEM INFORMATION ADAPTIVE SYSTEM

W Lane Kelly 804-827-3535
(506-61-13 506-54-63)

The primary objective of the Information Adaptive System (IAS) activity is to develop and demonstrate an on-board spacecraft data system which adaptively controls and processes sensor data. The IAS will interface directly with Earth resources and environmental monitoring sensors to provide on-board data control, formatting, calibration, preprocessing, data set selection and feature classification. The key hardware and software components required to implement a ground demonstration of the IAS will be developed and laboratory brassboard of the IAS will be demonstrated and evaluated in a simulated real-time data environment. IAS system design studies have been completed. Key IAS components have been identified and specified for development under contract in support of the brassboard demonstration. The Information Adaptive System is an essential element of the NASA/OAST NASA End-to-End Data System program and will provide a significant contribution in attaining the goals of this program.

W81-70261 **506-61-55**

Jet Propulsion Laboratory Pasadena, Calif
NASA END-TO-END DATA SYSTEM

Donald D. Lord 213-354-4117

(506-61-15 506-61-15 540-01-15)

The objectives of this effort are to define the system configurations and to develop enabling techniques and technologies which will significantly improve the effectiveness and efficiency of the NASA-wide information system for the 1980's. The principal emphasis of this effort will be directed towards identifying and resolving problems related to the Deep Space System. The approach includes performing a number of related tasks addressing key elements of the end-to-end system. Each of these tasks will be carried out so as to support and contribute to the activities of the established teams within the overall NEEDS program by representing the interests of the deep space community. Cooperative participation and continuing technical exchanges with other NASA centers is expected to aid in the identification of common (NASA-wide) approaches to a more effective and efficient end-to-end data system. Major categories of tasks include (1)

Systems systems engineering methodology development and technology assessment (2) Modular Data Transport System (MDTS) spacecraft data system channel coding, data compression and automated ground transport of telemetry (3) Data Base Management System (DBMS) DBMS systems/technology studies and the prototype implementation of elements of a deep space DBMS (4) Information Adaptive System (IAS) Optical Navigation Information Adaptive System (5) Command and Control (CC) Technology and requirements evaluation. Individual demonstrations and/or reports are planned to aid in the technology transfer process from the NEEDS efforts into flight project activities.

W81-70262 **506-61-56**

Goddard Space Flight Center Greenbelt Md
NASA END-TO-END DATA SYSTEM (NEEDS) PHASE 2

R D Price 301-344-7377

(506-61-53 506-61-55 506-61-59 506-61-16)

The NASA End-to-End Data System (NEEDS) extends from the detection of an event by a sensor to the output of data to the user and includes the planning and feedback of conditioning to the sensor for event detection. The objective of the NEEDS Program is to significantly increase the effectiveness and efficiency of this system through the development of advanced technologies and techniques. The broad objectives of Phase 2 are to develop and demonstrate subsystems and to define data systems configurations, operational procedures and data handling techniques which will enable real-time data management. The approach will be to conduct a continuing systems analysis to guide and evaluate the program to develop new subsystems and operations concepts and to integrate and test-demonstrate at the prototype level the composite system. The Goddard Space Flight Center (GSFC) as lead center on this program has responsibility for overall program management and coordination and leads or participates in most of the technology development. More specifically the technical approach has been divided into nine tasks (1) systems level support including program management and tradeoff studies (2) development of advanced data system concepts (3) information adaptive systems concept development (4) onboard image correction study (5) onboard ancillary data module study (6) modular data transport system development (7) data base management system software development (8) parallel processor development and (9) study of command and control concepts.

W81-70263 **506-61-59**

Marshall Space Flight Center Huntsville, Ala
NASA END-TO-END DATA SYSTEM (NEEDS) DATA BASE MANAGEMENT/ARCHIVAL MASS MEMORY

D T Thomas 205-453-3577

The objectives are to develop and demonstrate the low cost modular Data Base Management System (DBMS) and Archival Mass Memory (AMM) system. Space-acquired data will be received and recorded by the DBMS at rates up to 80 MB/sec. User-access time will be reduced (compared with previous systems) by a factor of 100. Input/Output rates up to 50 MB/sec will be routine for the AMM. It will provide online archival-quality capacity up to 10 to the 12th power bits with 10 to the 13th power off line and expandable to 10 to the 15th power.

Spacecraft Systems Research and Technology

W81-70264 **506-62-43**

Langley Research Center Hampton, Va

LARGE SPACE STRUCTURES SYSTEMS TECHNOLOGY

R L James 804-827-4606

Promising antenna and platform system concepts and supporting technology are being developed and tested to meet the needs of the NASA missions of the 1980's. The development activities include the evaluation of erector and deployable structures and the assembly thereof utilizing composites and other advanced materials. The supporting technology disciplines of stabilization and control techniques and their interaction with the structure materials, surface measurements and control techniques, and the utilization of interactive design and analytical programs are being fully explored and advanced by this program effort. Further, the antenna and platform requirements in the 1985 to 2000 time period will be examined so that technology

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

developed for the near term missions can be cost effectively extended for larger and more complicated systems The Langley Research Center is the lead center for Large Space Structures Systems Technology Program and the program will be managed by the Large Space System Technology (LSST) Program Office at Langley The LSST Program Office will plan and coordinate the technology development tasks among six participating NASA centers

W81-70265 **506-62-55**
Jet Propulsion Laboratory, Pasadena Calif
PLANETARY AND SOLAR SPACECRAFT SYSTEMS
AUTOMATED OPTICAL NAVIGATION
Allan R Klumpp 213-354-4209
(506-61-45 506-62-25 506-54-75 199-60-60)

The objectives of this work unit are (1) to develop and demonstrate ground-automated systems for optical navigation with significant new and improved capabilities and (2) to develop the technology base for autonomous onboard navigation systems required by advanced post-Galileo missions The approach includes analysis and assessment of present and anticipated navigation requirements, development of a prototype system to demonstrate the concepts on the Voyager mission and development of the prime optical navigation system for the Galileo mission The long-range goal is to increase navigation accuracy and scientific data acquisition capability while decreasing total costs The Automated Optical Navigation system (AON) will extract navigation measurements from full-frame TV images, determine a best-estimate orbit and compute a trajectory correction maneuver as a spacecraft approaches its intended target Its use can reduce navigation costs of future Galileo-type missions by over \$0.5 million per mission and future Voyager-type missions by over \$0.25 million per mission A prototype system on the IBM 370 mainframe computer was demonstrated in FY-79 on the Voyager Jupiter encounters An advanced system on the MODCOMP IV minicomputer will be demonstrated in FY-81 on the Voyager Saturn encounters Subsequently the system will be readied for Galileo supported primarily by OSS Design options and programming language have been chosen to facilitate adapting the system to an onboard computer when required for foreignbody landers sample returns and other advanced missions The technical plan for the AON work unit is consistent with the 17 Feb 1978 joint OAST/OSS Memorandum of Understanding Development of Approach Optical Navigation Automated Data Processing on the JPL Realtime Minicomputer System

W81-70266 **506-62-62**
Lewis Research Center Cleveland Ohio
EARTH ORBITAL PLATFORM SYSTEMS - AUXILIARY ELECTRIC PROPULSION FOR SPACECRAFT SYSTEMS
R C Finke 216-433-6119

The overall program objective is to characterize and verify the 8 cm thruster subsystem design and to provide for transfer of the technology to the user community The performance, lifetime, and interfaces of the 8 cm subsystem will be defined and verified in a ground program and a flight test of two subsystems on the Air Force P80-1 satellite Data from the ground and flight program will be evaluated, compared, and reported Relevant results and program status and plans will be provided on a timely basis to the interested community Works will be performed both by in-house and contracted efforts

W81-70267 **506-62-67**
Lyndon B Johnson Space Center Houston Tex
THERMAL MANAGEMENT FOR ON-ORBIT ENERGY SYSTEMS
W E Ellis 713-483-4941

The objective of this RTOP effort is to (1) develop the technology necessary for thermal management of a large space power or operation system (2) extend orbital lifetime capability of thermal management systems from months to several years and (3) provide the technology necessary for high energy density heat collection and transport This will be achieved by the design development, fabrication and test of prototype hardware comprising a representative portion of a full scale system Such a system might consist of an osmotic heat pipe providing a

constant temperature thermal buss or energy transport loop that would deliver or receive heat to/from the various systems and payload heat sinks or sources via one or more types of modular (i.e. easily connectable/removable) thermal interface devices (contact heat exchangers fluid or heat pipe quick disconnects etc) The primary heat sink for such a system could be made up of relatively simple independent radiator elements containing large high-capacity dual-passage heat pipes that would provide a space constructable radiator system with long life due to low system vulnerability to the micrometeoroid environment

Transportation Systems Research and Technology

W81-70268 **506-63-11**
Ames Research Center Moffett Field Calif
SPACE SHUTTLE CONFIGURATION AND AEROTHERMODYNAMICS
J G Marvin 415-965-5390

The objective is to provide the analytical and experimental support to the Shuttle Program Office as required for aerothermodynamic design development and verification of the shuttle orbiter launch and ferry configurations and subsystems The necessary expertise and facilities will be provided to support in-house and program-generated action items as required during the design development and verification of the Space Shuttle

W81-70269 **506-63-13**
Langley Research Center Hampton Va
SPACE SHUTTLE DEVELOPMENT SUPPORT
J P Arrington 804-827-3911

This RTOP focuses Langley's expertise in configuration aerothermodynamics and operational flight mechanics on specific Shuttle development requirements and problems The RTOP supports the Shuttle program by (1) providing time in Langley ground-based facilities for direct OSTS/contractor-requested support (2) continuing independent in-house Shuttle technology and development studies and (3) responding to specifically requested task-study areas from the Program Office at JSC In addition Langley will perform independent evaluations and assessments of the configurations and operational flight mechanics as necessary This RTOP's program is coordinated with other NASA Centers and the Phase C/D contractor through appropriate Program Office coordination panels at JSC

W81-70270 **506-63-27**
Lyndon B Johnson Space Center Houston Tex
ACIP - (AERODYNAMIC COEFFICIENT IDENTIFICATION PACKAGE)
Ernest L Weeks 713-483-4661

The objectives of the proposed experiment system are twofold (1) to acquire high quality flight data for postflight aerodynamic coefficient estimation and (2) to provide flight dynamic state variable data which would support other technology areas such as aerothermal or structural dynamics The proposed experiment consists of an instrumentation package and baseline Orbiter data which will provide flight mechanics data for the determination of aerodynamic coefficients from Orbiter flight data The data from the system will also provide appropriate reference conditions for other aerothermal and flight dynamics experiments This experiment would require power, time correlation, environmental support and a suitable structural location from the orbiter

W81-70271 **506-63-31**
Lyndon B Johnson Space Center, Houston Tex
OEX (ORBITER EXPERIMENTS) PROJECT SUPPORT
P D Gerke 713-483-3987

The Orbiter Experiments (OEX) Program has been initiated jointly by JSC and OAST to utilize the space shuttle as a research vehicle The program objective is to collect data in the technology disciplines that will augment the research and technology base for future spacecraft design Flight data relative to these disciplines will be collected by utilizing the currently planned development flight instrumentation (DFI) configuration by modifications and/or augmentations to the present orbiter flight tests (OFT) baseline instrumentation and by development of unique experiments beyond the DFI capabilities for flight on the orbiter Studies will be conducted to determine the optimum method of utilizing the shuttle system to conduct research and

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

technology. These studies will be augmented by investigations to develop experimental programs that would obtain research and technology data in flight regimes applicable to advanced space transportation systems. The primary goal of these studies is more efficient utilization of the STS capabilities to obtain data required to advance the current state of spacecraft technology. This RTOP includes the effort associated with overall project management, project support, experiment development initiation, experiment compatibility assessments, experiment integration activities and integration hardware development initiation. The experiment development effort is the subject of additional RTOP's from the appropriate NASA Centers.

W81-70272 506-63-32

Langley Research Center Hampton Va
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS)
P M Siemers 804-827-3984
(506-26-13 506-26-33 506-26-43)

To extend the knowledge of aerodynamics, aerothermodynamics and basic fluid mechanics into flow regimes previously inaccessible to the investigator through extraction of flight data during routine operation of the shuttle orbiter. This knowledge will be applied (1) to verify and increase the reliability of sophisticated computational prediction codes (2) to develop procedures to extrapolate windtunnel data to flight conditions (3) to improve the performance and operational capability of the STS and (4) to provide a data base for studies of future aeronautical and aerospace vehicles. The design, development, calibration and demonstration of the Shuttle Entry Air Data System will be accomplished through in-house (LaRC) analysis and test programs and contracted studies. A retrofitted instrumented nose cap incorporating the Shuttle Entry Air Data System, will obtain flight data which when reduced will produce the required air data parameter for each orbiter flight. These data in conjunction with inertial data, development flight instrumentation data, and data obtained by specialized instrumentation packages will be utilized to verify aerodynamics and aerothermodynamics performance as well as resolve many fluid mechanic questions.

W81-70273 506-63-34

Langley Research Center Hampton Va
SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING (SILTS)
J C Dunavant 804-827-3984
(506-51-13)

To extend the knowledge of the basic aerothermodynamics of leeside flow fields and heat transfer on large lifting vehicles into flow regimes which are inaccessible to investigations in ground facilities through sensing of leeside surface temperatures during Shuttle Orbiter entry with an infrared scanner. These data will permit development of improved leeside flow field and heat-transfer prediction techniques which are required to reduce considerably the weight and cost of thermal protection systems on the leeside of future space vehicles. This experiment utilizes a highly developed infrared scanner and recording system which will be qualified for the severe ascent environment in a development program at the Langley Research Center. The instrumentation and supporting equipment will be installed in a Langley manufactured engineering test model and tested at the Langley Research Center. The flight structural pod, exclusive of the dome will be manufactured by the shuttle orbiter contractor and the experiments will be installed in Orbiter 102 at KSC. The SILTS experiment will be flown on a number of early orbiter flights.

W81-70274 506-63-35

Ames Research Center Moffett Field Calif
INFRARED IMAGERY OF SHUTTLE
B L Swenson 415-965-5263

The purpose of this RTOP is to design, develop and conduct an experiment to be used in conjunction with the first orbital flights of Shuttle. The experiment is part of the Orbiter Experiments program (OEX) and will obtain measurements of surface temperature of the lower and side surfaces of Orbiter by means of remote high resolution infrared imagery. This imagery

is obtained on board the C-141 Kuiper Airborne Observatory (KAO). The experimental equipment to be developed consists of an acquisition telescope and appropriate servo system, cryogenically cooled focal plane and detector array and a data handling and storage system.

W81-70275 506-63-36

Ames Research Center Moffett Field Calif
OEX THERMAL PROTECTION EXPERIMENTS
H K Larson 415-965-5369
(506-53-31 506-51-31)

The overall objective of these experiments is to obtain a better understanding of Thermal Protection System (TPS) reentry heating effects that may permit TPS cost and weight reductions for Shuttle advanced Space Transportation Systems. Five separate experiments will be flown as test panels or tiles replacing baseline TPS on the Shuttle Orbiter during Orbiter Flight Tests (OFT) and operational flights. These experiments will take advantage of the real entry heating environment that cannot be fully simulated in ground facilities to demonstrate advanced TPS materials for possible Orbiter retrofit and to investigate TPS heating effects. Temperature data will be obtained with existing and follow-on Orbiter instrumentation. Baseline TPS procedures and tooling will be used and none of the experiments will impact orbiter operations. The experiment will be designed and fabricated by both in-house and contract efforts and experiments hardware will be provided as GFE.

W81-70276 506-63-37

Langley Research Center Hampton Va
SHUTTLE UPPER ATMOSPHERIC MASS SPECTROMETER (SUMS)
R C Blanchard 804-827-3786
(506-51-13 506-51-33)

The primary technological objective is to provide flight data for advances in the prediction of aerodynamic behavior throughout the high speed flight regime including the free molecular flow and the transition into the hypersonic continuum. This objective will be achieved through Shuttle Orbiter flight instrumentation including a Shuttle Upper Atmospheric Mass Spectrometer (SUMS). The specific objective of the SUMS system is to provide in-situ high altitude atmospheric data primarily neutral atmospheric mass density. A spare Viking flight-qualified mass spectrometer will be modified to provide atmospheric data in the high hypersonic flight regime. These data coupled with data from other proposed experiment systems will provide aerodynamic information on a winged entry vehicle in flight regimes heretofore unobtainable and will augment ground-based test facilities. In addition, experiment results on the Shuttle will provide a benchmark from which to evaluate additional entry technology research. The design, construction and system tests of the prototype Shuttle Upper Atmosphere Mass Spectrometer (SUMS) and the supporting analysis on the SUMS system design and implementation will bring the experiment to the flight readiness state.

Systems Technology Programs

Space Systems Studies

W81-70277 540-01-13

Langley Research Center, Hampton Va
INFORMATION SYSTEMS FOR EARTH OBSERVATIONS FOR SPACE
L S Keafer 804-827-3666
(506-62-63)

The objective of this RTOP is to identify technology needs and to recommend and plan associated technology developments for information systems applied in Earth observations from space. Close cooperation between space applications managers and technologists is required in order to focus on the technology development issues critical to a responsive OAST research plan. This work builds on the technology assessment of an advanced tropospheric observation system performed in FY-80 and culminates in specific research plans being recommended to OAST in the critical areas of Earth observation sensors and data management technology. The mission design activities will be performed in-house at LaRC while the sensor workshop and research planning activities involve intercenter, university and industry cooperation and require major contractual support.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70278

Jet Propulsion Laboratory, Pasadena Calif

SPACE MISSION UPLINK PROCESS CONTROL ARCHITECTURE

Terry D Linick 213-354-3161
(506-54-75 541-01-16 506-61-55)

The objective of this task is to develop a top level systems architecture for the uplink process control (often called sequencing) of deep space missions which will decrease operating costs and improve system responsiveness. The results will be used to make incremental improvements to existing uplink systems as well as to provide a new architecture for future space missions. The high cost and complexity of uplink process control systems on recent deep space missions (e.g. Voyager and Viking) strongly indicates the need for substantial performance and cost improvements and suggests that there is a high potential for obtaining such improvements. The basic approach consists of three closely coordinated related activities: (1) an analysis of past and current flight projects to determine which characteristics of uplink process control significantly impact system responsiveness and cost and to suggest how these factors can be modified to improve system performance and efficiency; (2) a top-down functional analysis (TDFA) to provide a complete and systematic identification of the basic structure and characteristics of efficient uplink process control; this approach will have the substantial advantage of being unconstrained by the structure of previously existing uplink process control systems and is therefore the complement of the analysis of past and current flight projects; and (3) design of a new multi-mission oriented uplink architecture based upon the new views provided by the TDFA and the lessons learned from the historical analysis of flight projects. The analysis of existing systems is targeted for completion in the second quarter of FY-81. The definition of the new architecture for uplink process control will be available by the end of FY-82.

W81-70279

540-01-16

Goddard Space Flight Center Greenbelt Md

GROUND DATA PROCESSING TECHNOLOGY OPTIONS ASSESSMENT FOR MISSIONS OF THE 1985-1990 TIME FRAME

J J Gitelman 301-344-7889

Previous history in NASA research and development and operational missions has shown that these systems were designed from space looking down i.e. design a space sensor that produces data get these data to the experimenters/users and finally attack the problem of translating these data to the information products required. This RTOP will lead to a ground up design process for new missions of the 1985 to 1990 time frame i.e. define the information products that are required and then design the space and ground data/information delivery system to obtain and produce the data/information necessary to derive the final information products. New technological approaches and techniques to efficiently perform the data to information conversion and data dissemination will be identified. The historical design from space looking down for NASA research and operational missions has generally caused a data bottleneck at the data dissemination and data analysis facilities. Some of the data are never converted to information while the data to information product process is a slow one when it does occur. With the coming of the Shuttle and the TDRS era the potential for total data bandwidth is overwhelming.

W81-70280

540-02-11

Ames Research Center Moffett Field Calif

SPACE SYSTEM STUDIES - INFORMATION AND SPACECRAFT SYSTEMS

J P Murphy 415-965-6549
(506-61-31 506-61-41 358-41-06)

The objectives of this RTOP are to identify and evaluate the technology requirements of advanced system candidates, investigate future space mission alternatives, assess the effects of technology advances, and provide a data base to support technology program selection and program planning. The approach is to conduct studies related to these objectives on potential mission concepts identified by OSS in Infrared Astronomy and

540-01-15

Planetary Probes In FY-81 work will be completed on the large ambient deployable IR telescope

W81-70281

540-02-12

Lewis Research Center Cleveland Ohio

SPACE PROPULSION AND POWER SYSTEM STUDIES

Thomas H Cochran 216-433-6897
(506-55-32 506-52-12 506-55-22 506-55-72)

The overall objectives are to identify the propulsion and power technologies which will enable or enhance future space missions to identify the propulsion and power requirements for these future missions to define the characteristics of systems which would contain advanced propulsion and power technology and thereby to determine the critical technology advances. Propulsion concepts which range from (and include) electric and chemical for orbit-to-orbit transportation and on-orbit control of spacecraft will be studied. Space power concepts for propulsion and spacecraft applications will be studied with emphasis in the areas of power generation, distribution transmission energy storage and thermal management. Emphasis will be placed on missions which are based on Large Space System Technology (LSST) because of the high technology challenge and the extensive technology interactions inherent in this class of missions. The effort will be coordinated with work at DOD and at other centers, especially the LSST Project Office at LaRC, and will thereby provide for the planning of OAST's research and technology programs.

W81-70282

540-02-15

Jet Propulsion Laboratory Pasadena Calif

FAR OUTER PLANETS SPACECRAFT TECHNOLOGY DEFINITION

M I Cruz 213-354-5109
(540-01-15 540-01-15 540-01-15)

In ten years a mission opportunity period will begin for a coordinated exploration of the far outer planets (Saturn, Uranus, Neptune and Pluto) utilizing the Jupiter gravity assist to deliver meaningful payloads to these difficult targets. Even with this advantage the design challenge is severe and new technology will be essential to accomplishing the objectives. In addition a direct mission to orbit Saturn and send probes to Titan and into Saturn's atmosphere is planned for the late 1980's. The technology for this mission is equally challenging. In a highly integrated study with a project definition companion study which JPL will perform for code SL and with the on-going SL Saturn orbiter dual probe study (Cronos) this task will accomplish the following objectives: (1) determine applicability of advanced technology by integrating new technology based capabilities into spacecraft and spacecraft/ground systems designs; (2) develop plans (performance, schedule and cost) for the enabling advanced technology to implement the defined project and identify new technology development requirements; (3) develop performance and technology guidelines for the development of the 1990's spacecraft ground downlink capability to support these 1990's missions; and (4) investigate concepts for an advanced scientific spacecraft system for the outer planets missions as a departure from the traditional three axis Mariner class spacecraft.

W81-70283

540-02-19

Marshall Space Flight Center Huntsville, Ala

SPACE APPLICATIONS OF AUTOMATION, ROBOTICS AND MACHINE INTELLIGENCE SYSTEMS (ARAMIS)

Georg vonTiesenhausen 205-453-2789

The study provides a cross-cut between major functional elements of representative future NASA mission models and available and expected options of automation, robotics and machine intelligence systems which would be applied to these functional elements. Required RDT&E investments, costs of soft and hardware, and systems integration cost will be determined as well as cost benefits obtained over using conventional systems. This is an overall systems approach to the role of advanced automation technology application in NASA's future missions.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

W81-70284 540-03-13
Langley Research Center Hampton Va
TECHNOLOGY REQUIREMENTS OF FUTURE INTEGRATED SPACE TRANSPORTATION SYSTEMS
J P Arrington 804-827-3911

The objective of this study is to identify and evaluate the technology required for the design and operation of advanced systems capable of meeting the goals of economical transportation within the Earth-Moon sphere of influence in the postshuttle timeframe. The intent is to analyze potentially attractive concepts which build upon the technology base developed for the Space Shuttle Program utilizing projected advances in the areas of materials structural design, propulsion, aerothermodynamics, design interaction and others. Definition of approaches to advanced system design and a detailed examination of the relative impact of assumptions as to achievable levels of various technologies offer a suitable means of identifying those technologies which are crucial as well as those most cost effective. This identification will be a primary output of the effort. An inherent characteristic of any such advanced system is that it offers clear and significant cost/capability advantages relative to current systems. Programs to provide solutions to key technology issues will be designed based on the results of these studies. The activity will be pursued through a series of contractual system studies, technology planning methodology-development studies and selected in-house analyses and an intercenter working group as required.

W81-70285 540-03-19
Marshall Space Flight Center Huntsville Ala
SHUTTLE DERIVED VEHICLE TECHNOLOGY REQUIREMENTS
M A Page 205-453-3425

The objectives of this effort are to identify and define technology requirements for shuttle derived launch vehicles to establish priority, schedule and funding and to determine economic leverages of technologies. A contract will be solicited on competitive basis for the study. The study effort will extend over eighteen months and can be conducted in two phases of nine months duration each with incremental funding after Phase 1. Phase 1 will consist of the basic vehicle configurations and requirements to identify and scope the technology that will be applicable to launch vehicles in general. Parametric trades will be conducted to establish the relationship of various degrees of technology. The second phase of the study will apply the trends established and information obtained in Phase 1 on general launch vehicles to the conceptual design of a selected typical launch vehicle to the depth required to drive out technology and to establish priorities, schedules, implementation plans, cost benefits and leverages technology program costs, etc.

W81-70286 540-04-10
National Aeronautics and Space Administration Washington DC
SPACE SYSTEMS AND PLANNING ANALYSIS
Stanley R Sadin 202-755-2403

The objective of this RTOP is to provide space program planning studies in support of OAST space technology program requirements assessments, planning and advocacy. The studies are intended to provide an analytical basis for planning activities in space R&T. Areas of work will include technology status and trends assessments, mission concepts and systems long range planning activities, program technology needs, requirements and opportunities. The major focus of this activity is the NASA Space Systems Technology Model, including its completion and maintenance.

Information Systems Technology

W81-70287 541-02-12
Lewis Research Center Cleveland Ohio
SATELLITE COMMUNICATIONS TECHNOLOGY
R E Alexovich 216-433-6689
(506-61-32 506-54-42 650-60-20)

The objective is to provide through research design and experimental tests the components, subsystems and enabling technology required to support OSTA's new emphasis in satellite communications systems. To achieve this objective, advanced research and development programs will be conducted to identify, produce and demonstrate critical components, techniques, and subsystems required for complete communications systems. Principal emphasis will be directed toward spacecraft microwave electron beam amplifiers with increased power output efficiency and high frequency capability, multifrequency, multibeam antennas providing increased frequency reuse and solid state materials and component technology for high frequency spacecraft applications such as switching, power conditioning and beam forming. Technology necessary for low cost earth terminals and for intersatellite data links will also be developed.

W81-70288 541-02-15
Jet Propulsion Laboratory Pasadena Calif
EARTH SATELLITE COMMUNICATION ANTENNA DEVELOPMENT
W J Weber 213-354-3845
(506-61-25)

The objective of this RTOP is to develop the RF portion of antenna technology necessary for demonstrating the service and technology of the land mobile satellite service (LMSS) system operating within the 806 to 890 MHz band. The LMSS system is a key element of the NASA narrowband program that provides low cost communications services to the user. One of the possible LMSS system configurations is the recently Joint U.S./Canada communications satellite project. A demonstration of the service and technology of the LMSS system is planned for the 1987 time frame using the concept of contiguous multiple antenna beams. It is therefore critical that necessary antenna studies be accomplished by the end of FY-82. Consequently, during FY-81 and FY-82, proof-of-concept technologies for the antenna subsystem will be developed and tested so as to reduce the risks for the demonstration project. These technologies include multibeam offset reflector antenna and feed designs, analytical techniques for predicting the effects on radiation patterns due to reflector surface distortions and feed position errors, efficient techniques for characterizing multibeam antennas and mobile antenna designs. Lens and phased array antennas will also be investigated as possible alternatives to reflector antennas.

Spacecraft Systems Technology

W81-70289 542-03-01
Jet Propulsion Laboratory Pasadena, Calif
DEVELOPMENT OF A SHUTTLE FLIGHT EXPERIMENT DROP DYNAMICS MODULE
T G Wang 213-354-6331

The principal objective of this RTOP is to design, fabricate and test an acoustic positioning and manipulation module for Spacelab and to utilize it to perform the experiment Dynamics of Rotating and Oscillating Drops as part of the NASA Physics and Chemistry in Space Program on early Shuttle/Spacelab flight. The module is scheduled to be ready for the ESA-NASA joint Spacelab mission, and will be available for Spacelab flights thereafter. This acoustic positioning and manipulation module will allow us to utilize the unique zero-g environment provided by a Shuttle/Spacelab flight to perform drop dynamics experiments that are impossible to perform in a gravitational field. Examples are to study experimentally the problems first proposed by Newton -- and never satisfactorily studied -- of equilibrium figures and the bifurcation processes of a rotating spheroid, and to understand the fission and fusion processes in drops that are also applicable to meteorology and nuclear physics. The scope of this work is threefold: (1) to determine the maximum capability of this facility within the constraints of money and schedule through consultation with the scientific community and investigators; (2)

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

to fabricate a flight unit and (3) to perform the experiment 'Dynamics of Rotating and Oscillating Drops' as part of the NASA Physics and Chemistry in Space Program. The scientific community will be invited to participate in experiments informally through international symposia and colloquia. Some scientists will participate with JPL as science associates and consultants.

W81-70290

542-03-04

Marshall Space Flight Center, Huntsville, Ala

SHUTTLE OPERATIONAL FLIGHT TEST OF THE SOLAR ELECTRIC PROPULSION SOLAR ARRAY

Rein Ise 205-453-2163

(506-23-19)

The objective of this RTOP is to provide overall demonstration of the availability of advanced solar array technology by flight testing the Solar Electric Propulsion (SEP) Solar Array as an experiment on the Shuttle. Demonstrating that the array will deploy and retract in a space environment and establishing its dynamic characteristics are objectives which are particularly important. The approach consists of four basic steps as follows: (1) define through study and analysis the requirements, criteria and conceptual design for the solar array experiment system; (2) perform a detailed design, build and test the flight array experiment; (3) install and fly the solar array experiment on Shuttle; and (4) evaluate flight results after return to Earth.

W81-70291

542-03-13

Jet Propulsion Laboratory Pasadena Calif

SPACELAB 2 SUPERFLUID HELIUM EXPERIMENT

G Lagomarsini 213-354-5110

An experiment to investigate the properties of superfluid helium in zero gravity is planned for flight on Spacelab 2 in early 1983. The experiment will determine the mechanical and thermal properties of superfluid helium in sufficient detail to enable the design of high performance space qualified superfluid cryogen systems. A companion experiment will study the properties of low velocity capillary waves in thin films of superfluid helium. These waves cannot be observed in the Earth's gravity. Their study will increase scientific understanding of the interaction of normal and superfluid helium. The experiment will consist of an instrumented cryostat, an experiment package mounted inside the cryostat, and an electronics control and data processing electronics package. It will be mounted on a Spacelab pallet and will interface with the Spacelab Command and Data Management System. Interactive control with experimenters on the ground will permit optimization of scientific results by real time modification of experimental conditions and parameters.

W81-70292

542-03-20

Jet Propulsion Laboratory Pasadena Calif

SPACE CALIBRATION OF SOLAR CELLS

Louis B Sidwell 213-354-5489

(506-55-45)

The objective of this RTOP is to take advantage of the space environment of Spacelab to correlate solar cell calibration data with those obtained from balloon flights. The Spacelab program will provide the opportunity to validate existing calibration procedures and to determine the most cost effective way of accomplishing solar cell calibration. During FY-81 support will be provided to the pre-integration and integration activities for the proposed May FY-82 flight of the Solar Cell Calibration Facility (SCCF). Retesting (system and environmental) to insure flight readiness will be accomplished prior to shipping the SCCF to the integration site. Candidate test solar cell specimens will be selected in advance of the Spacelab flight with similar solar cells to be flown on a high altitude balloon flight calibration experiment for comparative analysis. The RT funded balloon flight will take place during the same time frame as the Spacelab flight. On completion of both flights the RT funded data reduction will begin with completion and final report expected 180 days after data availability.

W81-70293

542-03-27

Marshall Space Flight Center Huntsville Ala

TRIBOLOGICAL EXPERIMENTS IN ZERO GRAVITY

R L Gause 205-453-1500

The experiment Tribological Studies of Fluid Lubricated Journal Bearings in Zero Gravity proposes the operation of a conventional journal bearing and of a journal bearing which utilizes ferrolubricants. Basic behavior characteristics of journal bearings operating in zero gravity should be provided by this experiment. The experiment Wetting, Spreading, and Operating Characteristics of Bearing Lubricants in a Zero Gravity Environment, will monitor the wetting process for selected lubricant surface combinations and provide an understanding of the mechanism of properly maintaining lubricant films and the effect of surface wettability on bearing performance and life in a space environment.

W81-70294

542-03-30

Langley Research Center Hampton Va

SEMICONDUCTOR MATERIALS GROWTH IN LOW-G ENVIRONMENT

R K Crouch 804-827-3661

(179-80-10 506-54-43)

The objective is to utilize the microgravity environment available on the Space Shuttle in such a way as to eliminate or minimize the segregation of constituents by minimizing the influence of thermal convection on the growth of semiconductor materials usable in making infrared detectors and tunable diode lasers. Studies in a 1-g environment will optimize growth procedures and analysis will include detailed comparison of space-grown and Earth grown crystals to provide data on important growth parameters needed to improve state-of-the-art Earth based processing.

W81-70295

542-03-52

Lewis Research Center Cleveland Ohio

CRYOGENIC FLUID MANAGEMENT

Thomas H Cochran 216-433-6897

(506-52-12)

A Shuttle Spacelab flight experiment to obtain data on the storage and supply of subcritical cryogenic fluids in a low-g environment will be designed.

W81-70296

542-04-13

Langley Research Center Hampton Va

LONG DURATION EXPOSURE FACILITY

R D English 804-827-3704

The broad LDEF Project objectives are the following: (1) to develop the Long Duration Exposure Facility (LDEF); (2) to develop and perform a first set of experiments on the LDEF; and (3) to broaden the operational STS user community. The LDEF a shuttle transported, reusable unmanned low cost free flying structure on which many different experiments can be mounted will be developed and manufactured in house at Langley. The experiments many of which are completely passive with active data measurements being made in the laboratory after recovery will be solicited from all NASA Centers, other government agencies, industry, and foreign countries. The STS user community will be broadened by the LDEF providing a unique simple low cost approach to perform large numbers of needed long duration technology and science experiments. The establishment of a continuing program to provide for LDEF reflights after the first LDEF mission with the operational STS is a part of this RTOP.

W81-70297

542-05-12

Lewis Research Center, Cleveland Ohio

FLIGHT TEST OF AN ION AUXILIARY PROPULSION SYSTEM (IAPS)

Rodney M Knight 216-433-5183

(506-62-32)

The objectives of this RTOP are to conduct in-situ tests of a one millipound mercury ion thruster auxiliary propulsion system over a representative duty cycle and time period to acquire engineering design information by which to determine the systems compatibility with host spacecraft to demonstrate to potential users the technology readiness of mercury ion thruster systems for auxiliary propulsion applications aboard operational spacecraft and to fly the experiment as part of the USAF/Space Test Project P80-1 (Teal Ruby) spacecraft.

Energy Programs

Space Utilization Systems

WB1-70298 **775-16-27**

Lyndon B Johnson Space Center Houston Tex

IN-SITU INSTRUMENTATION FOR DEVELOPING NUCLEAR WASTE ISOLATION SITES

J E Keith 713-483-5840

DOE in-situ tests to study the migration of nuclear wastes over tens of meters in various geological settings will begin soon. Such field tests will require several years to complete. The objective of NASA investigations carried out under this RTOP will be to develop and optimize instrumentation and data collection and analysis techniques to sense this migration while it is in progress without compromising the experiment. A theoretical model of the interactions of neutrons with geological materials will be built based upon a neutron transport code, detector response functions and previous experience with similar instruments. A laboratory mockup consisting of a neutron source, detectors and a large mass of geologic material capable of being instrumented with neutron foils will be built. This mockup will be operated to improve and validate the theoretical model and to discover the optimum operating conditions for information recovery. A breadboard field test unit will be assembled using the results of the laboratory tests and where possible parts from the mockup and field demonstration tests performed.

Solar Energy Systems

WB1-70299 **776-91-17**

Lyndon B Johnson Space Center Houston, Tex

REGENERATIVE FUEL CELL/ELECTROLYSIS CELL-HYDROGEN/HALOGEN

David Bell, III 713-483-6491

The objective of this research effort is to advance the hydrogen/halogen fuel cell and electrolysis cell technology to maturity and to demonstrate suitability to large energy conversion and storage requirements for high power long life life systems. A data base will be developed using a hydrogen/bromine 5 to 7 kW sized unit test. An engineering model will be fabricated and delivered for field demonstration. A data base will be developed to assess its potential to meet the bulk energy storage needs of future NASA and DOE programs.

WB1-70300 **776-91-19**

Marshall Space Flight Center Huntsville Ala

INTEGRATED MODULAR SOLAR ENERGY SYSTEMS (SMALL DISPERSED SOLAR ENERGY SYSTEMS APPLICATIONS)

W F Richardson 205-453-1746

The objectives of this RTOP are to select the most feasible solar energy system conceptual designs developed in FY-80 and to initiate the detailed designs and integration of those systems, and to prepare program planning documentation appropriate for a NASA program responsibility of supporting other U S Government Agencies in development and demonstration of those systems. The general approach will be to use the data and other information now being developed to generate the technical and managerial information requisite to preparation of procurement documents for the project implementation phase to follow. The method will be to use a time phased continuation of the present study to maintain and amplify the knowledge and skills gained during the first phase.

WB1-70301 **776-91-35**

Jet Propulsion Laboratory Pasadena Calif

STUDIES IN BIOENERGY

R H Green 213-577-9591

The objective of this RTOP is to perform the appropriate studies planning and technical verification tasks necessary to demonstrate the merit of NASA involvement in bioenergy. The NASA experience and expertise in biomass related technologies will be evaluated to identify develop, and demonstrate advanced

biomass energy delivery systems. The results of this work will provide the recommendations and supportive data necessary to determine the potential for an institutional role in the execution of the national bioenergy program. The above objectives will be achieved through the following approach with Jet Propulsion Laboratory serving as lead organization and responsible for coordination of the RTOP: (1) focus and refine the emerging biotechnology base and identify NASA center capabilities and roles through the selection and initiation of verification and demonstration tasks; (2) complete the multi-year NASA Bioenergy Plan to identify the potential NASA role and technology focus; and (3) prepare a bioenergy mission analysis, a preliminary implementation plan and select specific bioenergy delivery systems for further analysis and demonstration in FY-82.

WB1-70302 **776-91-40**

Marshall Space Flight Center Huntsville Ala

OCEAN THERMAL ENERGY CONVERSION STUDY AND ASSESSMENT

C R Ellsworth 205-453-1333

The objectives are (1) to investigate the program factors common to the Ocean Thermal Energy Conversion (OTEC) Program and NASA's developed capabilities (2) to determine the most feasible options for applying NASA's capabilities and resources to support the OTEC Program (3) to develop appropriate planning documents illustrating the findings and results of the study and (4) to define proposed options for NASA's role in support of the OTEC Program. The approach will be to review the existing and projected OTEC plans, compare this information with past and present NASA programs involving large hardware integration activities and identify the skills, facilities and programmatic interfaces of a potential OTEC mission for NASA. Typical MSFC capabilities applicable to OTEC development include materials research and test, structural dynamic analyses and test instrumentation and control analyses and design and power distribution analyses and design.

WB1-70303 **776-91-59**

Marshall Space Flight Center Huntsville Ala

SOLAR RANKINE CYCLE APPLICATIONS STUDY

W F Richardson 205-453-1746

This RTOP aims to determine the feasibility of increasing the size of solar Rankine devices to develop 200-1200 horsepower and/or generate electrical power in Megawatt capacities. Study results will indicate technical feasibility of such devices, design criteria and critical factors involved in the development phase. Trade studies and feasibility analyses will be performed using existing technology and available performance data on solar Rankine cycle devices. Assessments of the thermal range between 150F to 600F will be employed to determine feasibility of using low and high-grade process heat to provide the thermal energy for the Rankine cycle working fluids. Various working fluids will be assessed to select those for the thermal range in question. Various turbine and nozzle designs will be studied to obtain maximum performance of the Rankine unit. Analysis and performance mapping of power generation capabilities over the thermal range will be developed.

Conservation and Fossil Energy

WB1-70304 **778-45-12**

Lewis Research Center Cleveland Ohio

COMBUSTION TECHNOLOGY FOR POWER GENERATION

D A Petrasch 216-433-6860

The objectives of this work are to identify and verify NASA Lewis Research Center's aeronautical and space related combustion technologies for application to selected combustion needs of DOE and other organizations. These objectives will be attained through experimental studies to demonstrate technical feasibility of combustion concepts for energy projects, analysis of combustion designs for different applications and design studies to determine the need requirements approach, etc. The work will include (1) experimentally determining the potential

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

advantages of using steam-assisted fuel injection in premixing fuel preparation systems for use in stationary gas turbine power plants (2) evaluating catalytic combustion with and without steam injection for stationary gas turbines and (3) preparing reimbursable combustion technology plans as may be required

W81-70305

778-45-35

Jet Propulsion Laboratory Pasadena Calif
ENERGY PLANNING SUPPORT AT JPL

G E Nichols, Jr 213-577-9141

The objective of this RTOP is to support the initial problem definition and the subsequent preparation of approach papers, preliminary project plans etc. for activities in the area of energy conversion systems

W81-70306

778-46-12

Lewis Research Center Cleveland Ohio

POWER GENERATION CONCEPTS AND APPLICATIONS

L I Shure 216-433-4000

This effort will identify and evaluate national needs with respect to stationary power generation that can be solved by use or application of NASA's existing technology developed from aerospace programs in power and propulsion. Particular emphasis will be given to cogeneration applications. This will be accomplished through (1) the improved analysis capability and the analytical screening of advanced concepts for potential application to stationary power with emphasis on cogeneration (2) evaluation of advanced components and technologies applicable to advanced systems in a real environment and (3) preparation of energy research and technology plans proposed for implementation by DOE on a reimbursable basis that are responsive to their projected needs

W81-70307

778-46-22

Lewis Research Center Cleveland Ohio

STIRLING ENGINE COMPONENTS AND SYSTEM CONCEPTS

Donald G Beremand 216-433-4331

The purpose of this activity is to build upon the current Lewis Research Center capabilities and programs in Stirling engines to examine the Stirling engine in a broader way to evaluate opportunities and to derive its potential benefits of high efficiency, low exhaust emissions, low noise, and broad multifuel capabilities for other applications. This expertise will be applied to the development of reimbursable Stirling technology programs. The Stirling engine technology base will be broadened through in-house and contractual efforts that are complementary to established reimbursable programs. Early efforts will concentrate on acquiring a broad understanding in the areas of (1) determining the engine requirements and identifying the potential of the Stirling engine for a broad range of engine applications (2) acquiring experimental Stirling engine experience from a free piston 13 kW research engine with varied output load capability (including hydraulic output) (3) generating validated computer codes for predicting free piston Stirling engine performance (4) comparing alternate Stirling engines (free piston or kinematic single or modular engines) and (5) experimentally investigating component and subsystem technology within critical areas

W81-70308

778-46-35

Jet Propulsion Laboratory Pasadena Calif

VALIDATION OF STIRLING LAB ENGINE

G W Meisenholder 213-577-9148

The overall objective of this RTOP is to establish a coordinated NASA/University Stirling Engine Research activity. Specifically this effort is designed to stimulate research relative to Stirling cycle machines with the goal of broadening the technology base within the United States. NASA has significant Stirling development programs underway in advanced automotive propulsion and solar thermal electric systems. Stationary Stirling engines one of the most promising applications are in the conceptual stages

at DOE. A underlying problem behind all this activity is however, that with a few isolated exceptions, the technology base supporting these major commitments is held by a small number of foreign corporations. There is practically no on-going basic research or research and development base in the U.S. This shortcoming was one of the major themes in the First Annual Report to Congress on the Automotive Technology Development Program by DOE (Aug 1979). Previous NASA RTOPs at JPL have produced an operational preprototype Stirling Laboratory Research Engine (SLRE). The approach for FY-81 consists of the following (1) conduct a JPL fundamental research experiment in transient heat transfer and fluid flow (2) secure follow on support to the Stirling analytical modeling work of Dr. Michael J. Meurer Cal State LA. All of the steps outlined will be supported as necessary with the JPL SLRE.

W81-70309

778-47-15

Jet Propulsion Laboratory Pasadena Calif
ADVANCED COAL PROCESSING CONCEPTS

R L Phen 213-354-9145

The general objectives of this RTOP are to identify and verify new coal processing technologies that meet national needs for reduced costs of coal liquefaction and coal beneficiation while concurrently improving environmental characteristics of the resultant fuels. The two main elements composing this activity are (1) Coal liquefaction technology and (2) coal beneficiation technology. Each technology area will be directed by a study which will define the requirements and applications of the technology. The objectives of coal liquefaction technology will have the following tasks (1) To conduct a study to determine the outlook for synthetic liquids and a role for NASA/JPL in coal liquefaction on a national level and (2) to undertake critical coal liquefaction experiments in available test facilities on the following concepts (1) single step catalytic conversion to middle distillates (2) auto-catalytic conversion to distillate oils and (3) liquefaction in the high shear environment of a coal extruder. The coal liquefaction study will include assessment of liquefaction requirements, applicable technologies and the present roles of organizations conducting coal liquefaction system development to establish future liquefaction development needs and potential roles for NAS/JPL. Liquefaction tests will be carried out in the existing reactors. The technical feasibility of the three liquefaction concepts will be evaluated using test data.

W81-70310

778-47-29

Marshall Space Flight Center Huntsville Ala
COAL CONVERSION PROCESSES AND SYSTEMS

C R Ellsworth 205-453-1333

(778-50-29)

The general objective of this RTOP is to acquire an in-depth center knowledge and expertise in coal conversion systems whereby a creditable proposal for technology or demonstration related advancement can be submitted to the DOE, TVA or other energy related agencies offering reimbursable support responsive to their projected needs. This RTOP consists of the following tasks (1) Applications for Second and Third Generation Coal Gasifier Systems (2) Coal liquefaction systems technology assessment, and (3) Alternate fuel products from low/medium BTU coal gas. These tasks will consist of studies to develop background information and requirements for the several applications. These tasks will directly support the definition of a reimbursable project plan.

W81-70311

778-48-15

Jet Propulsion Laboratory Pasadena Calif

CONCEPTS FOR IMPROVED GROUND TRANSPORTATION SYSTEMS

G W Meisenholder 213-354-9170

The overall objective of this RTOP is the utilization of NASA system capabilities and communications and control technology in the area of Transportation Flow Management (TFM) to contribute to the critical national need for petroleum conservation. Studies conducted as part of current work for DOT JPL in-house efforts and the related FY80 RTOP have shown TFM to have potential for producing significant savings in petroleum fuel with attendant benefits of emissions reduction and travel time savings.

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

These efforts have also identified potential TFM applications for NASA technology and capabilities. Additional investigation and analysis is needed to better define requirements and benefits identify an appropriate role for NASA and develop a program plan for implementation of that role. The approach to achieving the above objective will be to (1) complete the investigation of TFM requirements initiated under the FY80 RTOP (2) utilize results of relevant studies to assess the benefits of selected TFM examples and extend these to aggregate national level benefit (3) compare identified needs and benefits with NASA capabilities and technology to develop a rationale for NASA involvement in TFM (4) develop an appropriate TFM role for NASA and a program plan for its implementation.

W81-70312 **778-48-17**
Lyndon B Johnson Space Center Houston Tex
WASTE HEAT AUTOMOTIVE AIR CONDITIONER
R R Richard 713-483-2497
(506-25-27)

Current research at the University of Texas at Austin has demonstrated a nonmechanical cryogenic refrigeration system capable of producing cooling at liquid nitrogen temperatures. The Molecular Adsorption Refrigeration System (MARS) employs an adsorption pumping concept similar to that used by the Serval Principle utilizing zeolite crystals (also called molecular sieves) for gas storage and subsequent pressurization through the application of heat. The capability to use heat energy for the refrigeration cycle makes it ideal for adaptation to automotive air conditioning and other applications wherein waste engine heat may be used as the primary source of power. The proposed effort will determine the optimal means of adapting the MARS technology to these consumer oriented energy conserving applications.

W81-70313 **778-49-15**
Jet Propulsion Laboratory Pasadena Calif
INDUSTRIAL CONSERVATION, COGENERATION AND UTILIZATION OF ALTERNATIVE FUELS
Y Nakamura 213-577-9247

The objectives of this RTOP are to assess the energy conservation potential in the application of NASA-developed technology and technology spin-offs to industrial processes. Specific objectives of the two proposed tasks are (1) Direct Contact Heat Exchanger for Caustic Flowstreams Demonstration and improved process for heat exchanger performance that will allow recovery of waste heat presently lost in caustic flowstream (2) Automation of Industrial Processes. Determine the energy conservation potential in the application of advanced sensor automation data acquisition and processing and control technology to selected industrial processes.

W81-70314 **778-50-15**
Jet Propulsion Laboratory Pasadena Calif
UTILITY POWER SUPPLY AND LOAD MANAGEMENT
E P Framan 213-354-9265

This RTOP has as its overall objective the focussing of NASA's systems capabilities control and communications disciplines and knowledge of evolving new power generation and storage technologies on the increasingly severe problems of electric utilities. The RTOP also addresses a number of topics in the integration and management of new technologies and in the application of NASA developed methods to power systems expansion planning. Practical tests with rigorous data acquisition and analysis are required to avoid a long repetition of demonstrations to convince the utility industry that the methods in question are practical. The approach will be to (1) focus and coordinate NASA's capabilities by a continuing education program at Jet Propulsion Laboratory, involvement in professional utilities system activities, assessment of NASA's capabilities, and to coordinate and develop integration activities at the NASA centers (2) perform a variety of technology identification and verification activities applying NASA capabilities to the utilities in the cities of Burbank, Glendale and Pasadena as a test site and (3) develop plans for reimbursably funded activities.

W81-70315 **778-50-29**
Marshall Space Flight Center Huntsville Ala
ADVANCED ENERGY TECHNOLOGY FOR UTILITIES
C R Ellsworth 205-453-1333
(778-47-29)

The general objective of this RTOP is to acquire an in-depth Center knowledge and expertise in Advanced Energy Conversion Systems whereby creditable proposals related to large scale field demonstration programs can be submitted to the DOE, TVA or other energy related agencies offering reimbursable support responsive to their projected needs. This RTOP consists of the following task (1) Advanced power generation systems technology studies for electric utility applications to include fuel cells, combined cycle gas turbines and other innovative systems. This task will consist of a study to develop and catalog status background information and application requirements for several power generation systems. This task will directly support the definition of a reimbursable project plan.

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

Technology Utilization-Identification and Dissemination

W81-70316 **141-20-11**
Hugh L Dryden Flight Research Center Edwards Calif
AERODYNAMICS OF GROUND VEHICLES
T R Sisk 805-258-3311

The overall objective of this RTOP is to improve the efficiency and effectiveness of ground vehicles through (1) improved external aerodynamics efficiency (2) improved ingestion efficiency for cooling and ventilation and (3) definition of traffic interference effects. Aerodynamic principles successfully applied to aircraft shapes will be employed using the coast-down techniques hot-wire anemometry, wind tunnel testing and flow visualization methods.

W81-70317 **141-20-21**
Ames Research Center Moffett Field Calif
REMOTE SENSING OF SUBSURFACE DRAIN MALFUNCTIONS
J P Millard 415-965-6360

The objective of this effort is to develop a Standard Mode of Operation for identifying malfunctioning drain lines in irrigated farmlands. Visible and thermal-IR techniques will be employed. To accomplish this objective, Ames Research Center will work with the USDA Imperial Valley Conservation Research Center. Ames will fly an 11-channel multispectral scanner over test areas provided by USDA. Both low and high altitude repetitive flights will be conducted to determine optimum times of year and required frequency of measurements.

W81-70318 **141-95-01**
Marshall Space Flight Center Huntsville Ala
COMMERCIAL PROTOTYPE FUSION-WELDING SYSTEM (COMPUTER CONTROLLED/CLOSED CIRCUIT TELEVISION ARC GUIDANCE)
W A Wall 205-453-4878

The objective of this RTOP is to develop and demonstrate a prototype fusion welding system suitable for technology transfer. Gas tungsten arc and gas metal arc (GTA and GMA) welding will be accommodated by the prototype. The basis for the prototype will be the recently developed MSFC weld skate. Weld guidance will be incorporated into the prototype with a closed circuit television (CCTV) weld guidance system which was separately developed at MSFC. Present equipment performance will be retained or enhanced while reducing cost via conversion from a minicomputer to a microprocessor based control system. Development will be done jointly by MSFC and contractor in three phases: evaluation/review of existing technology, design/build GMA model (convertible to GTA) around MSFC weld skate incorporating microprocessor control and CCTV arc guidance.

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

Demonstration (third phase) will be to commercial/aerospace and military hardware manufacturers

W81-70319 **141-95-01**

Marshall Space Flight Center Huntsville Ala

COMMERCIALIZATION AN ORBITAL TUBE FLARING SYSTEM

J R Williams 205-453-5089

The objective is to develop a prototype commercial, tube flaring machine capable of producing the precision flarings necessary for fabrication of leakproof long life tube joints. The manufacturing process for producing such machines will be refined concurrently with prototype development. Development of both prototype and manufacturing process will be done under contract. Present MSFC developed precision tube flaring performance will be equaled or exceeded. The contractor will demonstrate the developed prototype to commercial tube fabricators for sales purposes

W81-70320 **141-95-02**

Marshall Space Flight Center Huntsville Ala

PROSTHETIC URINARY SPHINCTER CONTROL VALVING SYSTEM

R Helms 205-453-5480

The objective of the project is to fabricate and test a simple reliable prosthetic urinary sphincter to enable urinary incontinent patients to achieve external voluntary control of bladder function. NASA technology and expertise in valve system design and manufacturing assembly checkout and installation processes are directly applicable to the design of this system. The solution was developed in response to a problem statement from the Research Triangle Institute Biomedical Applications Team. The objective will be accomplished by (1) implanting a cuff or collar around the urethra which occludes the passage of urine when fully inflated without causing tissue necrosis and (2) subcutaneous implantation of the single control valve and reservoir system for inflating the cuff in the male scrotum or female labium for easy external actuation

W81-70321 **141-95-02**

Marshall Space Flight Center Huntsville Ala

OCULAR SCREENING SYSTEM

R R Jayroe 205-453-5609

The objectives of the project are to develop an ocular screening system capable of automatically and numerically defining the optical status of an individual's pair of eyes and to define the upper limits of the diagnostic capabilities of the acquired image data. The end product is a hardware design of a commercial system that can be manufactured for under \$4500 and that has a false alarm threshold of 5% or less. In this project the device will principally be used to screen children for incipient ophthalmologic diseases which can later result in amblyopia blindness. This medical application of NASA's remote sensing technology is being supported by the Research Triangle Institute NASA Biomedical Application Team. The objectives will be accomplished by (1) upgrading and evaluating the screening system utilizing calibration data (2) making the system available for use by physicians in a clinical study which provides independent evaluation (3) and comparing the screening results and physician's examination results with NASA computer image analysis for possible extension of screening procedure into a diagnostic mode

Environmental Observations Applied Research And Data Analysis

W81-70322 **146-01-00**

Jet Propulsion Laboratory Pasadena Calif

SEASAT DATA UTILIZATION PROJECT

Pat Rygh 213-354-7240

The objective will be to complete the goals of the Seasat Data Utilization Project. The general objective of the Seasat Data Utilization Project is to determine the extent to which the Seasat-A serves to demonstrate the utility of microwave sensing from a satellite as an oceanographic tool as expressed by the performance goals of the original Seasat-A Project. The approach will be to continue the assessment of the SMMR and the SAR. The production of global data records for the SASS and SMMR will be extended. The real-time data distribution system of the

commercial demonstration will be continued. Publication of the evaluation results will be extended

W81-70323

146-10-02

Goddard Inst for Space Studies, New York

NUMERICAL CLIMATE MODELING

James Hansen 212-678-5593

Climate models are developed and applied to support NASA's role in the National Climate Program, particularly to help define requirements for observing systems. Appropriate climate modeling capability is developed to conduct numerical climate experiments including climate process diagnostic studies, measurement parameter sensitivity studies and observing system simulation studies

W81-70324

146-10-03

Goddard Space Flight Center, Greenbelt Md

CLIMATE RESEARCH

A Arking 301-344-7208

(146-10-03 146-10-02)

The aim of this RTOP is to conduct a broad based research program in support of the NASA Climate Program, including data base development, special studies of climate processes, climate modeling and analysis and climate observing system development. The specific approach is to (1) continue efforts to produce atlases of sea ice concentration from Nimbus 5 ESMR and radiation budget from Nimbus 6 ERB, and continue development of pilot climate data management system but defer hardware (2) complete guidelines for three special studies, continue cloud radiation experiment, including preparation for CCOPE, continue study of cryosphere processes and at a more modest level boundary layer processes, solar-climate coupling and soil moisture transport (3) continue climate sensitivity predictability and diagnostic studies with GLAS GCM and with SDM's develop coupled atmosphere-ocean model and improved methods of parameterization of climate processes and (4) continue efforts to develop concepts for a climate observing system with emphasis on precipitation, continue studies for improved radiation budget sensor and continue solar monitoring rocket flights

W81-70325

146-10-04

Ames Research Center Moffett Field, Calif

AEROSOL CLIMATIC EFFECTS SPECIAL STUDY

J B Pollack 415-965-5530

A coordinated set of theoretical laboratory, and field investigations of the chemistry and radiative properties of natural (e.g. volcanic) and man-made atmospheric aerosol particles are conducted in order to assess their impact on regional and global climate. The field investigations are intended to provide complementary information on aerosols to that being obtained from spacecraft platforms (e.g. SAM II and SAGE) so as to insure that a comprehensive set of aerosol properties are gathered for climate analyses. The theoretical and laboratory tasks are directed at interpreting and utilizing the aerosol data sets to perform the desired climate assessments. The centerpiece of the field investigations is a set of coordinated aerosol measurements, which are flown together on an appropriate aircraft platform (e.g. U-2). When possible these flights are conducted in conjunction with spacecraft and other airborne aerosol measurements. Information is obtained on both the aerosol formation mechanisms and on their radiative properties so as to enable the development of a predictive capability as well as determination of the present climatic effects of aerosols. Both theoretical modeling and laboratory studies are used to further define the mechanisms of aerosol formation, to provide hypotheses that can be tested by the field investigations, and to provide ultimately the predictive tools. Theoretical investigations involving radiative transfer dynamics and aerosol formation are utilized for making the climatic assessments

W81-70326

146-10-06

Langley Research Center Hampton, Va

RADIATION BUDGET AND AEROSOL STUDIES

James L Raper 804-827-3431

(146-10-03 146-10-02 146-10-04 146-10-03)

The objectives of this RTOP are (1) to develop and improve satellite based techniques for monitoring the spatial and temporal distributions of the Earth's radiation budget, and (2) to conduct studies of stratospheric aerosols using ground-based LIDAR techniques. The objectives will be accomplished by (1) performing sensitivity studies using existing radiative transfer models to establish radiation budget measurement capabilities (2) conducting investigations using existing satellite data to provide increased understanding of the Earth's radiation budget and limitations of current measurement capabilities (3) conducting advanced mission studies consisting of flight simulations, development of sampling strategies and retical performance and methods for improving instrument accuracy and precision through use of advanced-design sources and calibration techniques (5) developing a long duration easily accessible self-consistent radiation budget data set for the conduct of present and future investigations (6) providing studies of measurement requirements and recommendations for the synthesis of the radiation budget-related portion of the climate program (7) conducting ground-based measurements of atmospheric aerosols in support of satellite aerosol experiments using the LaRC 48-inch Lidar (8) investigating instrumentation contributions to discrepancies observed in Nimbus 6 ERB nonscanner measurements and (9) performing analyses to determine the diurnal variability of cloudiness on regional scales from GOES satellite data for application to radiation budget studies

W81-70327 **146-20-08**

Goddard Space Flight Center Greenbelt Md

GLOBAL TROPOSPHERIC MODELS MONITORING

Richard W Stewart 301-344-8895

(146-20-10 146-20-09)

The aim of this RTOP is to (1) develop an understanding of tropospheric environmental problems that may be amenable to solution through the use of remotely sensed data (2) develop, evaluate and demonstrate remote sensing concepts for observing the nature and distribution of tropospheric pollution (3) demonstrate the application of remote sensing technology to the specific problem of assessing the impact of urbanization and industrialization on global regional and urban air quality. The approach used will be to continue development of global tropospheric models for calculation of trace species concentrations and to evaluate and develop remote sensing techniques for the detection of visible evidence of polluted air masses and for trace species measurement. This RTOP supports the following major programs air quality, weather and climate. These in turn support the objectives of environmental management and technology transfer

W81-70328 **146-20-10**

Langley Research Center Hampton Va

APPLICATION OF REMOTE MEASUREMENT TECHNIQUES TO TROPOSPHERIC AIR QUALITY MONITORING

F Allario 804-827-2576

The objective of the RTOP is to develop a basic understanding of those environmental problems associated with the global troposphere through a coordinated program of atmospheric modeling and measurements from satellite, aircraft, and ground-based platforms. Remote sensing concepts for observing the nature and distribution of tropospheric pollution will be developed, evaluated, and demonstrated and the application of remote sensing technology to the specific problem of assessing the impact of urbanization and industrialization on global regional and urban air quality will be demonstrated. The approach for achieving the objectives will consist of a coordinated program in (1) global tropospheric modeling (2) experiment/instrument technique development (3) laboratory studies (4) field measurement studies and (5) program implementation

W81-70329 **146-20-23**

Ames Research Center, Moffett Field Calif

THEORETICAL STUDIES OF THE UPPER TROPOSPHERIC AEROSOL LAYER AND SAHARA DUST

O B Toon 415-965-5971

A three dimensional physical-chemical model of the formation evolution and transport of tropospheric aerosols is being

constructed. The model will first be applied to Sahara dust storms and tested against satellite and in situ observations. A one dimensional model will be used to study the chemical nucleation of aerosols in the upper troposphere. A laser system is being developed and tested for aircraft measurements of trace gases such as OH and HO₂. Fluorescence measurements and absorption measurements are being considered. Laboratory studies of the nucleation of binary systems of atmospheric interest are being conducted. At first simple binary systems will be considered to check the accuracy of theories of nucleation. Later studies of gases at pressures and temperatures appropriate to the atmosphere will be made. A radioactive tracer method of measuring the OH radical by measurement of the oxidation rate of CO, has been developed and successfully applied in the lower troposphere. Improvements will permit its use on moving platforms. Comparisons will be made with other (laser) instruments and with theoretical predictions

W81-70330

146-30-02

Goddard Space Flight Center Greenbelt Md

GLOBAL WEATHER RESEARCH

E A Neil 301-344-6291

(146-10-02 146-50-02)

The aim of this RTOP is to develop new and improved spaceborne remote sensing systems and collaborate with NOAA in improving the capabilities of the Operational Environmental Satellite System. Develop improved data processing and retrieval techniques to provide more accurate understanding of processes which influence state and behavior of the atmosphere and to utilize the capabilities of remote sensing for improving the accuracy of large-scale numerical weather forecasting. Theory, numerical models, laboratory measurements, and field experiments will be used to define, develop, and evaluate new and improved remote sensing techniques to observe profiles of atmosphere, temperature, moisture, and pressure, precipitation, surface properties, and atmospheric radiative properties. Infrared and microwave techniques for meteorological parameter retrieval and analysis and assimilation of satellite data into numerical forecast models will be studied and their impact on the models will be assessed. New and improved parameterization approaches, sounding techniques, analytical filtering techniques to improve forecast models will be studied

W81-70331

146-30-02

Marshall Space Flight Center Huntsville Ala

GLOBAL WEATHER RESEARCH

William W Vaughan 205-453-3100

(146-50-02)

The aim of this RTOP is to contribute to the NASA Global Weather Research Program objectives by performing geophysical fluid dynamics experiments and theoretical activities to develop a new and improved spaceborne sensing techniques, theoretical and laboratory models and improved understanding of atmospheric behavior by contributions to the development of more realistic general circulation models. The approach used will be to continue theoretical and experimental studies on potential Spacelab experiments to simulate the Earth's large-scale baroclinic atmospheric circulation, examine global weather processes to gain improved understanding between various scales of motion, continue to utilize satellite data to understand global atmospheric dynamic processes and investigate satellite Doppler Lidar wind system concepts

W81-70332

146-30-03

Langley Research Center Hampton, Va

AIRBORNE WATER VAPOR LIDAR

E V Browell 804-827-2576

(146-20-10)

An evaluation of the Airborne Differential Absorption Lidar (DIAL) System for making water vapor profile measurements in the boundary layer, troposphere, and tropopause regions of the atmosphere will be completed. These data will be analyzed to improve the understanding of atmospheric inhomogeneities and transport processes. Three dimensional water vapor profile information will also be studied to determine the usefulness of these data in weather forecasting. Flight tests of the

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

Airborne DIAL system will be conducted to determine the sensitivity of the system for measuring water vapor in the free troposphere and tropopause regions of the atmosphere. Lidar observations of water vapor in these and previous flight experiments will be used to improve the understanding of inhomogeneities and transport in the lower atmosphere. The field measurements, data reduction and data analysis will be done jointly with the University of Maryland and the National Center for Scientific Research France

W81-70333 **146-40-05**
Langley Research Center Hampton Va
MICROSCALE OCEAN SURFACE DYNAMICS
W L Jones 804-827-3631
(146-40-13)

The objectives of this research are to provide a physically unambiguous interpretation and quantitative utilization of active microwave remote observations of ocean conditions to assess the impact of same on relevant problems in oceanography and to publish results in the referred literature. The interactions between the microscale ocean surface features and electromagnetic waves as detected by active microwave sensors such as scatterometers and imaging radars will be investigated. Radar signatures of the ocean as a function of geophysical conditions and data inversion algorithms for retrieval of information on ocean's dynamic characteristics and wind stress will be developed. The approach taken is to establish contacts with most qualified theoretical fluid dynamicists who are able to provide assistance in the area of air sea interactions for the purpose of helping couple scatterometer data with the best models of processes at the air sea interface. Contacts will be established with scientists conducting field observational programs in small scale surface structures of the air sea interface to become better acquainted with the measurement requirements and difficulties associated with research in the marine boundary layer. Plan and implement airborne scatterometer missions will be planned and implemented in cooperation with these scientists. For FY-81 the emphasis is in the following areas: wave wave interactions, delta-k radar scatterometer/air sea interactions and scatterometer hurricane research.

W81-70334 **146-40-05**
Jet Propulsion Laboratory, Pasadena Calif
OCEAN WAVE HEIGHT DETERMINATION WITH THE SYNTHETIC APERTURE RADAR
Atul Jain 213-354-6614

The purpose of this work is to develop and analyze the capability of the synthetic aperture radar (SAR) to measure ocean wave heights. Two possible techniques have been identified for providing this measurement which are (1) obtaining radar images utilizing small sections of the total signal bandwidth, determining the normalized average intensity of pairs of such images as a function of frequency separation of the bandwidths used and measuring the rate at which this curve falls off (2) determining the shape of the envelope of the radar signal transform. The work in FY-81 is directed to evaluate unambiguously the ability of the SAR to provide wave height measurement and the physical limits over which this measurement is valid. Existing data and Jet Propulsion Laboratory (JPL) processing capabilities will be utilized to provide this evaluation. This will allow utilization of the SAR to provide wave height measurement in future SAR applications programs.

W81-70335 **146-40-05**
Goddard Space Flight Center Greenbelt Md
REMOTE SENSING OF AIR-SEA INTERACTIONS PHENOMENA
F C Jackson 301-344-5380
(141-40-13)

This RTOP has the broad objective of improving remote ocean sensing capability by microwave techniques. The following specific objectives refer to the three elements this RTOP comprises (1) to demonstrate a microwave radar technique for measuring ocean wave directional spectra from satellites (2) to refine the SMMR (scanning multichannel microwave radiometer) ocean algorithm and (3) to demonstrate the application of SMMR

data to large scale air sea interaction problems. Goddard short pulse radar data from the Fall '78 mission are analyzed to provide an experimental demonstration of proposed short pulse and two frequency nonimaging radar techniques. In-situ data from ships and buoys are used to refine and verify SMMR algorithms for sea surface temperature (SST) and wind speed. Selected SMMR data are analyzed for evidence of certain large scale air sea interactions (e.g., storm forcing).

W81-70336 **146-40-06**
Langley Research Center Hampton, Va
MICROWAVE REMOTE SENSING FOR ICE PROCESSES RESEARCH
C T Swift 804-826-3631

The prime objective of this work is to provide a physically unambiguous basis for the interpretation and quantitative utilization of combined active and passive microwave remote sensing of sea ice characteristics and to report the results in the refereed literature. The research will focus on the analysis of microwave data in hand both from the NASA C-130 flights conducted during the winters of 1978 and 1979 and polar data collected from the Seasat A Satellite scatterometer (SASS). The process of analyzing the Beaufort, Bering and Norwegian Sea data will require interfacing with Lewis, Goddard, and Jet Propulsion Laboratory in order to enhance the Langley data set. As the analysis develops new questions will invariably occur which can only be answered by conducting new flight programs. The planning will proceed as warranted and will require close coordination between the NASA Centers and the ice scientists. A second objective includes an evaluation task to define scatterometer performance characteristics for potential use as a satellite remote sensing instrument for ice processes. The purpose is to establish the scientific and technical necessity for providing 0 deg vs incidence angle through the research mode antenna proposed. System analyses will be continued to determine the data processing and engineering impacts of this research mode on the NOSS satellite. A joint plan will also be formulated with appropriate scientists for the analysis of data collected in the research mode.

W81-70337 **146-40-07**
Goddard Space Flight Center Greenbelt, Md
OCEAN CIRCULATION AND TOPOGRAPHY
J G Marsh 301-344-5324

The objectives of this research are to (1) provide physically unambiguous basis for the interpretation and quantitative utilization of remote sensing observations of sea surface topography (2) develop analytical and interpretive techniques for ocean circulation phenomena to satellite radar altimeter measurement of sea surface geometry and (3) formulate techniques for achieving orbital and ocean topography accuracies of 20 cm and 5-10 cm respectively. Satellite altimeter data will be analyzed to develop maps of the global oceans. Departures of this topographic surface from the geoid, or from the long term mean will be analyzed to yield information on dynamic ocean processes. Collinear Seasat and also GEOS-3 profiles will be examined to study temporal and mesoscale variability of ocean currents. The RTOP supports the following major programs (1) Seasat (2) NOSS (3) TOPEX. These in turn support the following end objective of improving our knowledge and understanding of the general circulation.

W81-70338 **146-40-12**
Jet Propulsion Laboratory Pasadena, Calif
SCATTEROMETER DATA ANALYSIS
Dudley B Chelton 213-354-5079

The objectives of this research are to help evaluate the usefulness of the altimeter and scatterometer for measuring sea surface topography and surface vector wind stress over the ocean and to use these measurements to statistically examine the dynamics of wind driven ocean circulation. The approach taken will be to compare the satellite measurements with available surface truth data in selected geographical locations to determine the quality of the satellite data. Based on the results of this stage of the analysis the work can then be extended to

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

study ocean-atmosphere interaction in regions where there is no available surface truth data

W81-70339 146-40-13
Wallop Flight Center Wallops Island Va
ADVANCED OCEAN SENSOR SYSTEMS DEVELOPMENT
J T McGrogan 804-824-3411
(146-40-05)

The objectives of this research are to provide a physically unambiguous basis for the interpretation and quantitative utilization of remote active microwave observations of oceanic conditions to assess the impact of same on relevant problems in oceanography, and to publish the results in the refereed literature to further develop satellite altimetry techniques towards supporting future missions such as TOPEX ICEX and related follow-on missions and to develop an overall plan that will identify the key technology that must be advanced and studies that are needed to investigate the potential of new techniques and system improvements. More accuracy easier calibration longer life more rapid coverage new products (i.e. directional wave spectra direct current motion measurements etc.) and more reliable performance over ice and land will be emphasized. Requirements obtained from future mission plans will be used to establish those sensor changes that are most promising for future implementation. New concepts will be analyzed and modeled, new hardware developed and tested and supporting studies conducted as required to firmly establish new sensor capabilities. An overall error budget will be used to help establish priorities for system improvements.

W81-70340 146-40-13
Langley Research Center Hampton Va
ADVANCED OCEAN SENSOR SYSTEMS DEVELOPMENT
C T Swift 804-827-3631
(146-40-05)

The objective of this work is to provide a physically unambiguous and accurate basis for the interpretation and quantitative utilization of remote passive microwave sensors in studies of physical biological and geological oceanic processes. The prime geophysical parameters of interest are salinity and temperature in both the coastal zones and open ocean and wind speed over the open ocean. The approach is to install Langley precision radiometer systems on board NASA and NOAA aircraft to collect data in collaboration with scientists affiliated with other Government agencies and reputable oceanographic institutions. Concurrent with this activity advanced passive sensors will be developed to expand the capability of existing passive microwave remote sensors. For example, the UHF radiometer system currently under development will provide much more accurate measurements of ocean salinity as the water temperature becomes cold. The work will also include the development of retrieval algorithms, analysis of data and reporting of results in the refereed literature.

W81-70341 146-40-15
Langley Research Center Hampton, Va
COASTAL AND ESTUARINE DYNAMIC PROCESSES RESEARCH
Janet W Campbell 804-827-2871

The objective of this research is to provide a scientific basis for the interpretation and utilization of remote sensing in studies of estuarine and coastal marine environments. Emphasis will be on developing the unique capability of remote sensors to provide synoptic mesoscale measurements to study dynamic biological, physical and geochemical processes and their interrelationships. Two major projects are (a) a continuation of the study of optical properties of turbid waters and (b) a new oceanographic remote-sensing experiment to study the coupling between the phytoplankton patch formation and the movement of water on Nantucket Shoals. Two new projects that are smaller in scope are (1) an intercomparison of existing techniques for converting a multispectral remote measurement to a true measure of water color and (2) a design study to consider the feasibility of integrating passive and active remote sensors into systems for meeting the needs of process-oriented marine science.

W81-70342 146-40-15
Goddard Space Flight Center Greenbelt Md
COASTAL AND ESTUARINE DYNAMIC PROCESSES RESEARCH
Hongsuk H Kim 301-344-6465
(666-32-21)

Important objectives of this RTOP are to develop a capability to observe ocean phenomena including ocean bio-productivity, ocean fronts and circulation features via aircraft or spaceborne ocean color scanners. Activities in FY-81 will focus on further application of colorimetry measurements to meso- and large-scale ocean phenomena by participating in field experiments such as, GABEX and STS-2/OCE. Chlorophyll distribution patterns in the ocean are an indicator of ocean bio-productivity and changes in water types which reflects the circulation and anomalies associated with main flow such as regional upwelling phenomena and meandering eddies.

W81-70343 146-40-18
Lewis Research Center Cleveland Ohio
GREAT LAKES WATER QUALITY RESEARCH
James W Bagwell 216-433-6196

The objectives of this RTOP are to validate CZCS data and data products relative to user needs to develop accurate radiative transfer models for the atmosphere and the water and to report the results of the CZCS validation experiment and make recommendations pertaining to the development of new sensors. The approach will be to identify the Great Lakes user community and determine their requirements. A large data base that is suitable for use with the radiative transfer models and for use in CZCS algorithm development will be developed. Products will be submitted to the user community for evaluation.

W81-70344 146-50-02
Goddard Space Flight Center Greenbelt Md
SEVERE STORMS AND LOCAL WEATHER RESEARCH
J Simpson 301-344-5948
(146-50-02)

The objectives are to (1) relate improved remotely sensed properties of cloud systems and their environment to the diagnosis, development and prediction of severe local storms and tropical hurricanes (2) adapt satellite data for numerical model initialization, improvement, assess VAS impact and (3) interact with user programs e.g. PROFS, CSIS, future satellite design teams. Methods to remotely measure from on-top crucial cloud and storm environment structure will be advanced and verified. With improved data assimilation display systems combined data sets (satellite, radar, aircraft, surface conventional) from cooperative field programs namely SESAME 79, VAS Demonstration WB-57F with Hurricane Strike CCOPE 81 will be constructed. Other approaches include performing case studies developing relationships between on-top incloud cloud interaction processes and methods to diagnose nowcast severe weather events as well as using models to relate data components and to perform numerical experiments on storm processes.

W81-70345 146-50-02
Marshall Space Flight Center Huntsville Ala
SEVERE STORMS AND LOCAL WEATHER RESEARCH
William W Vaughan 205-453-3100
(146-30-02)

To contribute to the NASA Severe Storms and Local Weather Research Program by conducting applied research and development using space related techniques and observations that will increase the basic understanding of storms and local weather to improve the accuracy and timeliness of local weather forecasts and severe weather warnings. The talents of university and private contractor groups plus the MSFC in-house talents and laboratory capabilities will be used.

W81-70346 146-60-01
Goddard Space Flight Center Greenbelt, Md
OZONE DATA REDUCTION AND ANALYSIS AND SOLAR UV VARIABILITY
Donald F Heath 301-344-6421
(147-10-01 147-30-01)

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

The objectives are to (1) develop stratospheric ozone climatology from satellite observations and investigations of processes and spatial and temporal from natural variability of stratospheric ozone (2) adapt LIDAR system for OH/O3 measurements from aircraft (3) provide ozone profile data in support of satellite measurements (4) investigate forms of solar activity and its effect on middle atmosphere and (5) solar flux and electrodynamic coupling Measurements of ozone UV solar flux and solar activity are analyzed in a variety of ways ranging from providing validation from rockets for satellites and harmonic and ozone trend analyses to producing inputs for verification by GCM's for the investigation of ozone and solar flux changes on the dynamics of the atmosphere Existing instrumentation is adapted for OH/O3 measurements from aircraft The RTOP studies of the upper atmosphere environmental quality and climate These in turn support the end objectives of determining the natural variability of the stratosphere and its role as well as that of the sun a parameter which might produce changes in climate

W81-70347 **146-60-01**
Langley Research Center, Hampton Va
STRATOSPHERIC MEASUREMENT PROGRAM ACTIVITIES
James M Russell III 804-827-2576
(147-40-01 147-30-01)

The overall objective is to develop evaluate and apply remote sensing technology to environmental monitoring of the stratosphere with the long range goal of providing this technology to those agencies charged with monitoring the stratosphere Specifically, work will focus on developing and evaluating remote sensor technology for stratospheric measurements on developing data interpretation techniques for satellite sensors on developing techniques for correlating ground aircraft rocket balloon and satellite data and on using available analytical models to expand existing and future data sets and provide the rationale for future measurement sets The approach will be to study and develop advanced concepts for long duration observation of stratospheric species to define key species in major chemical chains and use these results to study measurement requirements and to support the advanced concepts to develop and apply techniques needed to form a data base from all relevant sources and to compare existing data from ground aircraft balloon rocket and satellite measurements to use the data base to form reference models which can be compared to transport and radiation to gain improved understanding of physical processes and to design remote sensing strategies

W81-70348 **146-60-01**
Wallop Flight Center Wallop Island Va
IMPROVED MEASUREMENT AND CALIBRATION TECHNIQUES FOR STRATOSPHERIC TRACE SPECIES
T W Perry 804-824-3411

This RTOP aims to improve the quality of data from a variety of rocket-borne, balloon-borne and ground-based measurement systems used in support of the Upper Atmospheric Research Program and to identify future correlative support requirements and develop mission plans to meet these requirements The approach includes (1) laboratory studies to evaluate and improve accuracy and precision of ECC ozonesonde data under simulated stratospheric conditions (2) investigations into the incorporation of temperature sensors into rocket optical ozonesondes and into providing ranging capabilities for ECC balloon ozonesondes rocket meteorological datasondes and rocket ozonesondes (3) completion of the International Rocket Ozonesonde Intercomparison Project aimed at establishing instrumental precision and accuracy and at developing a common data base among the participating nations (4) determination of accuracy and precision and improvements in calibration techniques for rocket-borne chemiluminescent ozonesondes (5) intercomparison of five different ground-based total ozone spectrophotometers (6) development of a portable total ozone spectrophotometer for field use and (7) development of mission plans to meet future correlative support requirements

W81-70349 **146-60-02**
Langley Research Center, Hampton Va
ENVIRONMENTAL MONITORING RESEARCH SATELLITE MISSION STUDIES
Edwin F Harrison 804-827-2977
(146-60-01 147-40-01)

The objectives of this RTOP are to perform mission analyses flight simulations and experiment definition studies for advanced flight programs aimed at remote measurements of atmospheric constituents Orbital analysis along with data sampling simulations will be conducted to determine the spatial and temporal coverage capabilities of various satellite experiments in meeting the measurement requirements established by scientific and user groups In particular trade-off analyses between Shuttle launch time orbit inclination and altitude will be made to maximize the geographical coverage of atmospheric Spacelab experiments such as Space Lidar Statistical sampling analyses will be conducted to define measurement opportunities for various Space Lidar experiments when taking into account cloud cover variability A parametric study will be performed to optimize scan modes and operation duty cycles for the experiments selected for the Upper Atmospheric Research Satellite The approach is to use existing in-house analytical techniques to address the orbital mission analysis and sampling studies These analyses will be conducted in collaboration with scientific working groups for satellite mission definition The computer simulations will be carried out by a combination of in-house and contractual efforts

W81-70350 **146-60-03**
Langley Research Center Hampton Va
ATMOSPHERIC LIDAR SYSTEM DEFINITION
J E Harris 804-827-3951

Atmospheric Lidar Multi-User Instrument System Definition activity will be continued with emphasis on system development risk reduction through prototype laser source development evaluation This RTOP will also continue experiment analysis using realistic shuttle lidar system parameters and atmospheric conditions The central objective of this research effort is to design fabricate and test a modular laser source which will have most of the optical parameters that would be necessary for inclusion in an atmospheric lidar instrument capable of being flown on a spacelab experiment This will be a phased effort in cooperation with specialized industry expertise The phases will include (1) the construction and testing of a 2 joule TME sub 00 Nd Yag laser source utilizing where possible existing military qualified components especially those components which have been developed to a high degree of reliability and performance (2) the building and testing of a frequency doubling module that could frequency double the 2 joule 10 Hz laser output (3) the design and development of a dye laser module which would be added to the basic laser module and frequency doubler module (4) the testing of the dye module to assure reliable means of frequency tuning and the investigation of several methods of maintaining operation at the desired wavelength and (5) an aircraft and flight testing of the combined three module subsystem integrated with an existing lidar and data acquisition system

W81-70351 **146-90-03**
Goddard Space Flight Center Greenbelt, Md
COST ANALYSIS OF SPACE FLIGHT SYSTEMS WITHIN THE OFFICE FOR SPACE AND TERRESTRIAL APPLICATIONS
Paul Villone 301-344-7179

The objective of this RTOP is to provide supported and detailed mission cost and manpower estimates for Goddard Space Flight Center (GSFC) candidate missions within the Office for Space and Terrestrial Applications A combination of in-house and out-of-house effort by the Resources Analysis Group (RAG) is required to support the above objectives The following task areas are included (1) data collection (2) data analysis (3) data integration (4) development of cost estimation techniques (5) updating of cost estimating relationship (CERs) and (6) generation of cost estimates

Upper Atmospheric Research**W81-70352**

Goddard Space Flight Center Greenbelt Md

UPPER ATMOSPHERE RESEARCH - FIELD MEASUREMENTS

R D Hudson 301-344-6358

The objectives of this research are (1) Determine the specific local chemical and physical interactions in the atmosphere by a combination of theoretical studies and coordinated in situ measurement campaigns from balloon rocket and aircraft platforms (2) Investigate the variations and perturbations of the chemical and physical state of the atmosphere, i.e. variations with altitude solar conditions season latitude and perturbations from volcanoes tropical storms industrial and agricultural activity (3) Develop and calibrate selected instruments for local and remote investigations of the atmosphere The approach to the research effort is (1) To develop a balloon borne lidar system a Michelson interferometer spectrometer, sub-millimeter radiometers, and a photoionization mass spectrometer to measure the concentrations and diurnal variations of trace stratospheric species (2) To perform laboratory studies of the resonance fluorescence of stratospheric species by single and two photon excitation in support of the lidar experiments (3) To measure ozone and the direct and diffuse components of the solar flux in the stratosphere and mesosphere and (4) To perform multi-instrument coordinated measurements of minor species in the stratosphere and mesosphere

W81-70353

Lyndon B Johnson Space Center Houston, Tex

IN-SITU MEASUREMENTS OF STRATOSPHERIC OZONE AND TOTAL CHLORINE

D E Robbins 713-483-5039

The objectives of this RTOP are to (1) measure total chlorine mixing ratios in the stratosphere with enough accuracy and precision to extend the knowledge of stratospheric photochemistry (2) measure stratospheric ozone concentrations in situ simultaneously with other species linked photochemically with ozone to support correlative studies and (3) measure ozone profiles up to 48km simultaneously with French group and intercompare results Whole air stratospheric samples will be collected cryogenically from a balloon platform and returned to ground where the chlorine content will be determined using neutron activation analysis An existing ozone instrument which uses ultraviolet photometry will be flown piggy back on balloon platforms of investigators measuring other species involved in ozone photochemistry After completing certain modifications in the existing ozone instrument's design, it will be flown on dedicated balloon platforms along with a French instrument which employs chemiluminescence to measure ozone The two instruments have comparable accuracies and temporal resolutions The improved NASA-JSC instrument will be capable of observing ozone densities as low as 10 to the 11th power molecules/cm³ with an accuracy of 2% and a precision of 0.5% Both instruments are capable of making measurements higher than 48 km

W81-70354

Jet Propulsion Laboratory Pasadena Calif

STRATOSPHERIC RESEARCH, FIELD MEASUREMENTS PROGRAM

W T Huntress 213-354-2140

The overall objective of the JPL Upper Atmospheric Measurements Program is to obtain measurements needed for understanding the basic physics chemistry and transport of the upper atmosphere Highest priority is given to those measurements necessary for assessing the extent to which man's technological activities may affect the upper atmosphere At present five techniques are included in the program (1) infrared interferometry (2) infrared heterodyne radiometry (3) millimeter and submillimeter radiometry (4) pressure modulation infrared radiometry (in collaboration with Oxford University) and (5) laser absorption spectroscopy The first four of these are remote sensing techniques with instruments having already been developed for balloon or aircraft The fifth technique measures absorption between a balloon gondola and lowered reflector an instrument is now being developed A major FY-81 goal of the JPL program is to fly the four remote sensing instruments mentioned Above together on

a multi-sensor balloon gondola (already constructed) to simultaneously obtain many measurements needed for understanding stratospheric chemistry, particularly the chlorine cycle of ozone destruction HCl ClO ClONO₂ CH₃Cl CFC₁₃ CF₂Cl₂ HC H₂O H₂O₂ O₃ CH₄ NO₂ NO N₂O HNO₃ and possibly HO₂ HOCl HO₂NO₂ N₂O₅ and COS Longer term goals of the program include continued multi-sensor balloon measurements as needed and certain measurements (e.g. ClO) with individual sensors

W81-70355

Langley Research Center Hampton Va

EVALUATION OF ADVANCED SENSOR CONCEPTS FOR SATELLITE MONITORING OF THE STRATOSPHERE

M P McCormick 804-827-2466

The objective of this RTOP is to develop satellite sensor concepts for the measurement of upper atmospheric trace gases and aerosols by performing balloonborne spectrometer measurements of UV-visible solar earth-limb extinction At Langley this area of research is being supported by three RTOPs Under this 147-10-02 program balloonborne spectrometer measurements are made in the solar extinction geometry These data are analyzed under the 146-60-01 program providing spectrometer specifications and feasibility for the conceptual design of advanced satellite sensors throughput source and constituent strength analysis and channel selection via the measured spectra for SAM II SAGE and SAGE II programs and spectrometer characteristics for future balloon flights and improved measurement techniques The objective of this program is to also provide stratospheric profiles of trace gases such as NO₂ OH ClO etc The conceptual satellite sensor hardware design studies utilizing these data and analyses are supported by the 146-60-02 program with primary funding under contract to Ball Aerospace

W81-70356

Ames Research Center Moffett Field Calif

ATMOSPHERIC PROCESSES, EXPERIMENTS AND SYSTEMS

W A Page 415-965-5404

(146-10-04 146-20-23)

The objective of this research is to obtain observational data regarding the vertical transport into the stratosphere of tropospheric species (such as CFMs N₂O sulfur compounds and water vapor) and the latitudinal and downward transport of stratospheric species (such as NO_x O₃ HNO₃ and aerosols) and to develop and integrate new airborne instrumentation to measure key trace gas species on board aircraft aircraft and balloon platforms The ability to make coordinated simultaneous measurements is being emphasized Of interest currently is the important vertical transport that is thought to occur in tropical meteorological events such as active ITCZ periods midlatitude jets and in antarctic regions The approach is to form experiment working groups composed of theoreticians and experimenters to design the appropriate observational missions to participate in making and analyzing measurements and to evaluate the results of the missions Inasmuch as the regions of interest are the upper troposphere and the lower stratosphere aircraft are excellent platforms Typical experimenters use a medium-altitude aircraft such as the CV990 or Lear Jet and a high-altitude aircraft the U-2 each of the aircraft carries several instruments in order to measure all the species of interest Ancillary meteorological data are collected by special balloon soundings from neighboring weather stations and from meteorological satellite coverage

W81-70357

Goddard Space Flight Center Greenbelt Md

UPPER ATMOSPHERE RESEARCH - LABORATORY MEASUREMENTS

R D Hudson 301-344-6358

The objective of this research is to measure chemical kinetic rate coefficients of importance to the stratosphere and mesosphere The laboratory effort in chemical kinetics uses existing equipment of unique capability for the purpose of measuring absolute rate constants of reactions of importance in current models of the stratosphere Rate constants are measured as a function of

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

temperature and pressure and under conditions in which the number of atoms is much less than the number of molecules

W81-70358 **147-20-01**

Jet Propulsion Laboratory Pasadena Calif

CHEMICAL KINETICS

W B DeMore 213-354-2436

A program of laboratory studies will be conducted in the following areas (1) chemical kinetics of the upper atmosphere (2) photochemistry of the upper atmosphere (3) data survey and evaluation and (4) ionic processes in the upper atmosphere. The program will be designed to provide data needs and guidance for both chemical models and field measurements. Primary emphasis will be on the acquisition of kinetic data including reaction rate constants, temperature dependences and product formation. Photochemical quantum yields, absorption cross sections and product distributions will be measured. A broad base of data knowledge in all the foregoing areas will be maintained through literature surveys and through contract with other groups active in these areas. Laboratory studies will be conducted on ionic processes in the upper atmosphere in particular ion-molecule reactions important in the natural and perturbed mesosphere.

W81-70359 **147-20-03**

Ames Research Center Moffett Field Calif

QUANTITATIVE INFRARED SPECTROSCOPY OF MINOR CONSTITUENTS OF THE EARTH'S STRATOSPHERE

R W Boese 415-965-5501

Remote detection and measurement of stratospheric species via spectroscopic techniques is being routinely employed to develop a better understanding of this portion of our atmosphere and man's effect upon it. Proper interpretation of these measurements relies strongly on having the correct laboratory data. The objective of this work is to obtain laboratory measurements of basic molecular parameters, such as rotational line intensities and half-widths, absorption band intensities, vibrational and rotational constants, vibration-rotation interaction constants, line position measurements including pressure induced shifts and Franck-Condon factors. The determination of these parameters, and their dependence on pressure and temperature, will be obtained by using long path gas cells cooled and heated cells and high resolution interferometers and spectrometers.

W81-70360 **147-30-01**

Goddard Space Flight Center Greenbelt Md

UPPER ATMOSPHERE RESEARCH - THEORETICAL STUDIES

R D Hudson 301-344-6358

The objectives of this research are (1) Provide the framework for developing and understanding an organized solid body of knowledge of the physics, chemistry and dynamics of the Earth's upper atmosphere (2) Analyze data from upper atmospheric flight programs and (3) Predict and assess the effects of natural and man-related perturbation on the atmosphere. Approaches include (1) Develop a simplified one dimensional model for sensitivity and error propagation analyses (2) Develop a diurnal detailed chemistry, one dimensional models for studies of stratospheric photochemistry (3) Develop a global general circulation model (4) To study the NIMBUS 4 and NIMBUS 7 ozone data to elucidate dynamical effects and global trends (5) To use data from instruments on the Solar Maximum Mission to study mesospheric chemistry (6) To evaluate current knowledge of the upper atmosphere.

W81-70361 **147-30-01**

Langley Research Center Hampton, Va

STRATOSPHERIC THEORETICAL STUDIES AND SCIENCE DEFINITION ACTIVITIES

R H Tolson 804-827-2530

The objective of this RTOP is to conduct theoretical studies of stratospheric phenomena in conjunction with the analysis of stratospheric data and computational chemistry studies of reactive stratospheric molecules. Using contemporary satellite data, theoretical studies will be performed in the general areas of photochemistry, trace constituent budgets and the effects of a

sudden stratospheric warming. Balloon measurements of NO and NO₂ will be inverted, interpreted for diurnal variations and compared to time-dependent model calculations. These results will be related to LHS experiment definition studies. Computational chemistry studies will focus on determining the ground state structures, excited states and heat of formation of NO₃.

W81-70362 **147-30-01**

Jet Propulsion Laboratory Pasadena Calif

PHOTOCHEMICAL MODELING OF TRACE SPECIES IN THE STRATOSPHERE AND MESOSPHERE

R T Watson 213-354-2231

This work will be performed via an R&D contract to Professor Y L Yung, California Institute of Technology (Caltech Contract 064207). He will use the one-dimensional diurnal photochemical model to investigate the distribution of minor species in the stratosphere and mesosphere in support of the JPL joint balloon experiments. An understanding of the partitioning between the ClO family (ClO, HCl, HOCl and ClONO₂) and the NO_x family, NO, NO₂, HNO₃ and HO₂NO₂, and measurement strategy will be one of the primary objectives. In addition photochemistry and transport of O, O₃ and CO in the mesosphere will also be modeled.

W81-70363 **147-30-02**

Ames Research Center Moffett Field Calif

STRATOSPHERIC RESEARCH

E F Daniels 415-965-5527

(147-20-03 346-10-04)

The objectives of this research are to increase our understanding of the dynamics, thermodynamics and chemical composition of Earth's stratosphere and mesosphere to assess the effects of natural and man-caused perturbations on their structure and composition (e.g. the radiative balance and the ozone abundance) and to collaborate with the academic community to advance atmospheric model development. Several types of chemical-dynamical and dynamical models of the stratosphere and mesosphere have been or are being developed to study the complex interactions of radiative photochemical, chemical, and transport processes including the effects of vertically propagating internal waves and stratospheric-tropospheric exchange. Also, diagnostic analyses of the three dimensional velocities and thermal structure of the upper troposphere and stratosphere will be made to provide standards for comparison with the models' simulations. Research includes a three dimensional model being developed at Ames, development of a low wave number semi-spectral model of the middle atmosphere at the University of Washington, diagnostic studies of the northern hemisphere at San Jose State and Ames, analyses of stratospheric exchange in the tropics based on the NASA-Ames ITCZ experiments by scientists at Ames and the Center for Environment and Man, and computational support of a detailed aeronomical model at Harvard. Ab initio computations of molecular processes important to stratospheric photochemistry are also being carried out.

W81-70364 **147-30-02**

Goddard Inst for Space Studies New York

STRATOSPHERIC MODELING

James Hansen 212-678-5593

Multidimensional atmospheric modeling is utilized to analyze coupling between stratosphere and global climate with emphasis on radiation effects. Atmospheric modeling capability is developed for the stratosphere and troposphere as required to analyze interactions between the stratosphere and global climate. Models are utilized to help assess potential climatic implications of stratospheric change and to help define measurement requirements associated with assessment of stratosphere/climate interactions.

W81-70365 **147-40-01**

Goddard Space Flight Center Greenbelt Md

UPPER ATMOSPHERE RESEARCH SATELLITES (UARS)

DEFINITION STUDY

P T Burr 301-344-8536

The UARS mission objective is to understand (1) the mechanisms that control the upper atmosphere structure and

variability (2) the response of the upper atmosphere to natural and anthropogenic perturbations and (3) the role of the upper atmosphere in climate. To achieve these objectives the UARS will study (1) the energy input and loss in the upper atmosphere (2) the global upper atmospheric photochemistry (3) the dynamics of the upper atmosphere and (4) the coupling among processes and between atmospheric regions. The objective of this RTOP is to perform the necessary studies that will explicitly define the two UARS spacecraft and their ground analysis requirements. Documentation required for a FY-82 new start execution phase will be prepared including an Execution Phase Project Plan. During CY-80 technical support will be provided to headquarters and study contracts will be issued to each chosen investigator in the June to July period. Contracts for mission design studies will be issued in FY-81. The results of these studies will be used to produce the Execution Phase Project Plan. By solving technological concerns early the studies will ensure an on-schedule and within cost project.

W81-70366 **147-40-01**
 Langley Research Center Hampton, Va
LASER HETERODYNE SPECTROMETER (LHS) BRASS-BOARD
 Frank Allario 804-827-2576
 (506-61-33)

The objective of this research is to develop a two gas simultaneous laser heterodyne spectrometer (LHS) experiment to measure tenuous gas molecules in the stratosphere from aircraft and balloon platforms using the solar occultation technique. Target molecules for this investigation include ClO, ClONO₂, HOCl, HO₂, H₂O₂, HNO₂, HO₂NO₂, and N₂O₅. The LHS brassboard instrument will perform measurements from an aircraft (NASA CV-990) and a balloon platform (> 38 km). Aircraft flight tests will be conducted in CY-82 and a balloon flight program will be conducted in CY-83.

Space Processing

W81-70367 **179-20-55**
 Jet Propulsion Laboratory Pasadena Calif
ADVANCED CONTAINERLESS PROCESSING TECHNOLOGY
 T G Wang
 (179-70-10)

The primary long-range objectives of this task are to (1) study and advance the science of contactless positioning and manipulation of a high temperature acoustic chamber (2) provide design information on a flight version of this chamber for material science studies in a contactless and zero gravitation environment (3) provide potential MPS investigators with a set of ground-based facilities with which to perform precursor experiments. Presently JPL is under contract to develop a high temperature ACES for early OSTA shuttle flights. However many important facets of high temperature containerless processing technology have not yet been established, and some of the more sophisticated processing technology required for future shuttle flights is not available today. Detailed experimental and theoretical studies of containerless processing technology to be performed in this task will enable us to meet stringent requirements in the future. The objectives to be addressed in FY-81 are experimental and theoretical studies of (1) acoustic positioning and manipulation capabilities of a rectangular chamber as a function of temperature and pressure (2) various acoustical geometries which may have special application in materials science studies, (3) loss mechanisms associated with high intensity and high temperature acoustic waves (4) aero-acoustic positioning system which will allow us to levitate heavy samples in the laboratory (5) liquid-liquid positioning system which will allow us to study the dynamics of liquid melts and (6) positioning and manipulation capability of a KC-135 acoustic module. In addition a new effort will be initiated this year to provide potential MPS investigators a set of facilities which will allow investigators to examine and compare the properties of their samples processed in the following four ways: one-g contained, one-g containerless, zero-g contained and short duration zero-g containerless.

W81-70368 **179-20-56**
 Jet Propulsion Laboratory Pasadena Calif
ELECTROSTATIC CONTROL AND MANIPULATION OF MATERIALS FOR CONTAINERLESS PROCESSING
 M M Saffren 213-354-2352

The objective is to demonstrate techniques and develop technology for electric field positioning and manipulation of materials for containerless processing. Investigator applications Electric field containerless processing apparatus satisfying requirements of potential investigators will be demonstrated no later than CY-83. This will lead to the design of flight facilities and also laboratory theoretical and numerical study. KC-135 and Shuttle flights will be utilized. The objectives and approach of the two task elements are development of requirements of potential investigators and Electric Field Positioning Science Working Group to be formed will guide technology by imposing well-defined specific requirements. This Group will play the major role in defining facility requirements. An individual investigator would be funded through response to NASA AN's and the funding administered under this RTOP. Behavior of liquid drops in electric fields is to be applied to electric field positioning cloud physics fusion target technology and illustration of physical principles. The work deferred from FY-80 will be completed in FY-81. In addition an acoustic/electric field positioning apparatus to help study electric field positioning of bulk objects will be designed and tested. Conceptual design of a specflight test of electric field positioning will begin. The modes of compound drops which produce centering will undergo quantitative study. The interaction of the melting/freezing process and electric field positioning will be studied. A film/video-tape utilizing electric control of drops will be prepared for the NASA Film Library. The Science Working Group will be constituted there will be two meetings this year.

W81-70369 **179-20-57**
 Jet Propulsion Laboratory Pasadena Calif
FUSION TARGET TECHNOLOGY STUDY
 T G Wang 213-354-6331
 (179-80-30)

The objectives of this RTOP are to (1) study the physical processes that are associated with the fabrication of inertial confinement fusion (ICF) targets in a weightless environment (2) determine jointly with DOE centers the need for extended zero gravity in the future production of ICF targets (3) provide technical information to DOE centers that is pertinent to their current target fabrication research. In order to produce the high quality fusion target shells that are required four fundamental physical processes must be understood: spheroidization of the shell, uniformity of shell thickness and coating, adiabatic expansion and contraction of the molten pellet, and solidification of the molten pellet as it passes through temperature and temperature gradient environments. The present pellet manufacturing techniques are not set up to study these processes separately. Attempts to conduct experiments on the dynamics of liquid bubbles (molten pellets) in laboratories are limited by insufficient pellet size for accurate observation, limited time for experimentation and a strong coupling between the two parameters, time and temperature which precludes identification of the fundamental processes. The work described here will circumvent these limitations and enable detailed study of each of the important processes through use of low gravity environments collectively available within the KC-135 aircraft facility, in drop towers in a neutrally buoyant immobile system and in an acoustic levitation system. The primary activities of this task in the next year are to (1) study the fluid dynamics processes that pertain to pellet fabrication processes such as bubble centering, coating uniformity and various instabilities (2) study the effects of various temperature levels and temperature gradients on pellet fabrication (3) construct Earth-based high-temperature and high-temperature gradient drop towers (4) initiate development of a process for the fabrication of metal and metallic glass shells, (5) conduct theoretical studies and numerical analyses on various pellet fabrication processes.

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

W81-70370 179-70-10
Jet Propulsion Laboratory Pasadena Calif
ACOUSTIC CONTAINERLESS EXPERIMENT SYSTEM (ACES)
D Kerrisk 213-354-2566
(179-20-55 179-80-30 179-20-57)

The objectives of this RTOP are (1) to develop and demonstrate a breadboard for a first flight Acoustic Containerless Experiment System (ACES) capable of performing useful science and achievable with current technology and (2) to undertake the technology development effort needed to expand the science capability of future ACES. JPL is working with the ACES Science Working Group (SWG) during FY-80 to define the capabilities that should be incorporated in a first flight ACES and to establish science priorities for expansion of those capabilities for later ACES flights. On the basis of the SWG recommendations JPL will produce by the end of FY-80 a program plan for FY-81 and FY-82 which includes the conceptual definition of a breadboard ACES to be built during FY-81 and FY-82 which would allow the development of a flight ACES to begin in FY-83 with high technical confidence and low cost risk. The programming plan will also identify the technology development activities needed to expand the capability of later ACES in accordance with science priorities. During FY-81 the detail design of the breadboard ACES and the facility for its test and evaluation will be undertaken and procurement/fabrication of the breadboard subsystems, and preparation of the test facility will be initiated. This activity will continue into FY-82. Concurrently the technology development effort defined in the program plan will be set in motion.

W81-70371 179-80-10
Langley Research Center Hampton Va
INFRARED DETECTOR MATERIALS RESEARCH
R K Crouch 804-827-3661
(542-03-30)

The objective is to develop techniques to grow bulk semiconductor single crystals that are required for future infrared detection and electronic device development. Analytical studies and laboratory investigations will be conducted to define better the causes of crystalline defects such as voids, dislocations, grain boundaries and inhomogeneities in these materials. Special emphasis will be placed on crystal growth in space.

W81-70372 179-80-10
Jet Propulsion Laboratory Pasadena Calif
INFRARED DETECTOR MATERIALS PREPARATION
John A Zoutendyk 213-354-3214
(179-02-62 179-03-62)

The research program is aimed at the exploitation of the low-gravity space environment for the growth of single-crystal materials for infrared (IR) detectors having characteristics unattainable in an earth-gravity growth configuration. The long-term objective is to determine the effect(s) of gravity-driven convection in crystal growth of the IR semiconductors PbSnTe and CdTe (the latter is a substrate material for HgCdTe epitaxial crystal growth). The objectives for FY-81 are to perform ground-based crystal growth experiments and characterization of the resulting materials. Vapor-phase growth of PbSnTe will be done at JPL and liquid-zone growth of CdTe will be done under contract at Rockwell Science Center.

W81-70373 179-80-30
Jet Propulsion Laboratory Pasadena Calif
GLASS RESEARCH
G Neilson 213-354-6365

This RTOP relates to the Materials Processing in Space effort. It consists of two distinct, but related efforts (labeled A, and B) aimed at dealing with fundamental and practical questions pertaining to the processing of glasses in space. Studies A and B focus on the use of MOD (metal organic derived) or gel materials for glass preparation in space. Effort A is an investigation aimed at elucidating the properties and behavior of MOD glasses specifically the phase separation and crystallization behavior. This program will be performed at JPL. B is an applied research effort aimed at producing ultrapure optical fibers from such gel

glasses and is being pursued at Battelle Memorial Institute. Programs A and B were initiated via responses to an AN, and currently consist solely of ground based research work.

W81-70374 179-80-80
Jet Propulsion Laboratory Pasadena Calif
BIOSEPARATION
Alan Rembaum 213-354-3189

The long term objective of this RTOP is to electrophoretically separate cell subpopulations in space which are very difficult or impossible to separate on the ground. The study of the experimental conditions required to separate red blood cells (human and sheep) of high and relatively uniform electrophoretic mobility has been completed. The absence of gravity and therefore thermal convection in space eliminates one important obstacle for optimum electrophoretic resolution of cells of nonuniform mobility. Therefore the specific goals for FY-81 are (1) the study of the experimental conditions to determine the limit of ground based electrophoretic separation of cells of lower and less uniform electrophoretic mobility, (2) the study of the viability of the separated cells and (3) design of a flight experiment to demonstrate improved electrophoretic separation of cells with a lower and less uniform mobility. Various techniques are at present used to separate biological cells. In many cases these techniques are relatively successful. However some cell subpopulations are morphologically identical but immunologically very different and cannot be separated or isolated by any available means. One of the most promising possibilities for a solution to this problem is the application of immunological principles used in cell labeling, i.e. interaction of fluorescent antibodies with cell subpopulations. This successful immunofluorescence technique is now widely used to identify different types of cells which have an identical shape and form even when examined in the most powerful electron microscopes. Attempts to use electrophoretic methods to separate cells labeled with fluorescent antibodies were not successful because the electrophoretic mobility of labeled cells was not sufficiently different from that of unlabeled cells. We have demonstrated in FY-80 that human (hrbc) as well as sheep red blood cells (srbc) can be easily separated in free flow electrophoresis instruments. This separation was achieved by labeling the cells with microspheres carrying fluorescent antibodies on their surface, i.e. immunomicrospheres. The labeling altered the electrophoretic mobility of hrbc and srbc sufficiently for a successful electrophoretic separation on the ground.

Technical Consultation and Support Studies

W81-70375 643-10-01
Jet Propulsion Laboratory Pasadena Calif
TECHNICAL CONSULTATION SERVICES
W J Weber 213-354-3845
(643-10-02)

The objective of this RTOP is to ensure the growth of space applications by providing the technical basis and regulatory framework needed to obtain sufficient spectrum/orbit to meet current and projected requirements. The results of this work will be used by NASA to help determine its frequency and orbit requirements and to ensure compatibility between NASA flight programs and other space and terrestrial services. The results will also be used by NASA and other government agencies for the purpose of supporting CCIR and World and Regional Administrative Radio Conferences in making decisions on frequency/orbit utilization and assignments ground-station and satellite approvals and in providing for the growth of existing and new satellite services. The approach in general is to participate in studies for NASA CCIR and Administrative Radio Conferences. These studies include frequency/orbit use justifications, sharing criteria and implications, technical system standards, digital system modeling, frequency reuse characteristics of multiple beam antennas, spectrum conservation aspects of various modulation and coding techniques, multiple access and on-board signal processing and switching for more efficient satellite utilization and intersatellite links. Specific tasks and studies for FY-81 include

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

sound broadcasting via satellite broadcast satellite technology multiple beam antenna performance analysis transponder linearity/modulation tradeoffs digital TV modulation evaluation satellite capacity doubler adaptive antenna feasibility multi-beam antenna-concepts and technology institutional studies for the land mobile satellite service

W81-70376 **643-10-01**
Lewis Research Center Cleveland Ohio
TECHNICAL CONSULTATION SERVICES
E F Miller 216-433-4000

The objective of this RTOP is to provide technical consultation services support in the area of space services with particular emphasis on preparing for international meetings relating to the broadcast-satellite service (BSS) the fixed-satellite service (FSS) and the mobile-satellite service (MSS) provide the technical basis and regulatory framework needed to obtain sufficient orbit/spectrum to meet current and projected requirements of NASA and the United States and to perform studies, conduct evaluations identify technology status and needs perform measurements (where necessary) and evaluate alternatives that result in efficient use of the geostationary orbit/spectrum resource In support of the 1983 WARC (World Administrative Ratio Conference) we will develop analytic methods and tasks for planning examine alternate planning approaches determine parameters and cost determine sharing criteria and perform critical technology developments applicable to the BSS In support of the 1984/1986 Space Services WARC we will develop and evaluate alternative regulatory approaches determine planning parameters including sharing criteria examine alternate planning approaches identify technological risks and costs and examine the spectrum efficiency advantages of digital television for the FSS In support of the 1982 Mobile Services WARC we will determine example MSS systems develop sharing criteria by analysis and measurements and develop a simulator of mobile communications channels We will also conduct the described activities within the framework and schedules of the applicable CCIR Study Groups the special preparatory committees established in the U.S. and the international meeting called to support preparations for the Conferences Efforts described are a combination of in-house and contract activities

W81-70377 **643-10-02**
Jet Propulsion Laboratory Pasadena Calif
COMMUNICATION SATELLITE APPLICATION SYSTEMS
W J Weber 213-354-3845
(643-10-01 643-10-03)

The technical objectives of this RTOP include aid in providing for the growth of existing satellite services and new communications satellite applications and ensuring compatibility of NASA's communications flight programs with other space and terrestrial services This aid is particularly related to NTIA's charter to facilitate the transfer of space technology for public service applications Government procedures require all agencies to submit proposed new space systems concepts to IRAC and OMB for review four to six years prior to their planned date of initial operation This is to ensure spectrum availability for telecommunications systems prior to commitment of public funds In order to fulfill this requirement this RTOP will include studies of systems concepts with potential applications within the NASA Communications Program These studies will include conceptual designs user functional requirements technical requirements system descriptions frequency and bandwidth requirements cost effectiveness system tradeoffs and sharing studies required to demonstrate compatibility with existing or planned services Studies for FY-81 will include the land mobile satellite service satellite communications systems concepts for the Pacific Ocean region, satellite communications for utility control monitoring and load management and other potential narrowband services for commercial and public service applications The studies will be consistent with an integrated narrowband program plan within the NASA Communications Program

W81-70378 **643-10-02**
Lewis Research Center Cleveland Ohio
COMMUNICATIONS SATELLITE APPLICATIONS SYSTEMS
J R Ramler 216-433-4000

The objectives of this effort are to (1) identify and characterize multi-service thin-route (MSTR) markets suitable for satellite service and determine the role of satellites for providing these services and (2) identify and define the technology developments and service demonstrations required to verify that cost-competitive spectrum-conservative MSTR operational satellite service could be delivered in the 1990's The approach will be to conduct the following in-house and contracted studies (1) market/economic studies (2) system concept and competitive systems analyses and (3) institutional and regulatory assessment studies

W81-70379 **643-10-03**
Jet Propulsion Laboratory Pasadena Calif
SYSTEMS COORDINATION SUPPORT
William J Weber 213-354-3845
(643-10-01)

At the present time propagation uncertainties represent major constraints in Earth-space propagation in the mobile service and above 10 GHz This RTOP supports the improvement of our knowledge of the propagation mechanisms in Earth-space propagation the preparation of predictive models for such propagation the validation of these models through comparison with measurements and the preparation of reports and presentations of the results to allow the work to be evaluated by the scientific community The output of the work will be made available in forms which will be appropriate to the needs of those organizations involved in the effective utilization of the frequency spectrum for space applications (e.g. FCC IRAC CCIR WARC) Improvement in the estimation of link performance will be the guiding concern in this work It is planned that this program will be carried out in concert with systems planning of flight projects thus insuring the relevance of the propagation studies Anticipated products include (1) CCIR reports to Study Group 5 (sky noise temperature including the effects of clouds and rain and extraterrestrial emissions) and Study Group 6 (extraterrestrial propagation Faraday rotation on Earth-space paths) (2) contributions to NASA propagation handbooks (3) presentations at meetings of URSI and IEEE Antennas and Propagation Society (4) journal articles and (5) computer programs

W81-70380 **643-10-04**
Jet Propulsion Laboratory Pasadena Calif
REMOTE SENSING FREQUENCY COORDINATION STUDIES
N F de Groot 213-354-3768
(643-10-01)

The objective of the RTOP is to ensure effective remote sensing projects through the best utilization of allocated radio frequency bands and to provide the basis for appropriate frequency assignment in those bands There is a need to coordinate radio frequency requirements for OSTA remote sensing project prior to requesting frequency assignments through established channels There are a number of reasons for this coordination (1) The World Administrative Radio Conference (WARC) has recently allocated a large number for frequencies for active microwave sensors passive microwave sensors and associated data read-out frequencies Whenever possible NASA satellites should operate in the allocated frequency bands where their operations will be protected from harmful interference as well as protected from the interruption which could occur if the satellites should operate in non-allocated bands and cause harmful interference (2) Alternatives can be examined and advice provided to OSTA managers engineers and scientists when problems having programmatic impact arise in frequency selections (3) Programmatic plans for development of operational systems can be factored into frequency selections to ease the transition from experimental to operational projects The approach of this RTOP will be to assist in the selection of bands to be used by remote sensing projects from the stand point of sharing the bands with other

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

radio services as well as from the standpoint of instrument requirements

W81-70381 **637-01-02**
Jet Propulsion Laboratory Pasadena Calif
SYSTEMS FOR UNDERWATER SURVEY AND EXPLORATION (SUSE)
W Gulizia 213-354-3651

The purpose of this RTOP is to continue to demonstrate the applicability of space program derived systems techniques and advanced technology to facilitate and expedite undersea exploration and operations. Use will be made of the existing digital deep-towed instrument platform coupled with its shipboard data processing system to provide an in-situ test and demonstration capability to advance the technological needs and techniques of expressed value to the ocean community and for which a unique capability exists at JPL. These may include, but are not limited to, such technologies as solid state TV imaging, improved sub-bottom profiling, synthetic aperture sonar, improved power systems, laser scatterometer, advanced data systems with near-real time mosaicking capability, and artificial intelligence. It is a long range objective to this effort to evolve in the direction of an increasingly sophisticated underwater vehicle system—a self-contained, maneuverable, free-swimming vehicle. The approach will utilize JPL capabilities in the design of digital data processing systems and instrument platforms. Design techniques and software developed through NASA/JPL sponsorship of the Unified Data Systems (UDS) Remote Terminal Unit (RTU), Artificial Intelligence (AI) Image Processing (IP) and Advanced Teleoperator Technology will be utilized wherever appropriate in the advanced deep-towed submersible system design. A multi-disciplined design team has been formed of JPL personnel experienced in design of digital signal and data processing displays, computer image processing, power sonar instruments and electronic packaging. The Marine Physical Laboratory of the Scripps Institution of Oceanography will participate in the development of the submersible system as consultants to provide assistance in the areas of sonar instrument design theory, vehicle operations, electrical performance of the tow cable and ocean surveying requirements.

W81-70382 **637-01-03**
Langley Research Center Hampton Va
SYSTEMS FOR MARINE ENVIRONMENT PREDICTION (AIRBORNE ACTIVE/PASSIVE MICROWAVE)
W F Croswell 804-827-3631

The technical objective of this RTOP is to provide a technology transfer of the results of NASA remote sensing research to user oceanic agencies such as NOAA to fulfill their regional operational requirements for airborne measurements of selected ocean properties. Typical applications could be the winds and significant wave height in the vicinity of pollution accidents such as oil spills and in other instances timely surface temperature and salinity distributions to aid in circulation studies, etc. For FY-80 the work focused on studies to define user measurement requirements, establish national priority needs, and begin the development of technology transfer plans which include operational implementation. For FY-81 the results of user studies will be analyzed, system and instrument design initiated and user involvement developed.

W81-70383 **637-01-04**
Jet Propulsion Laboratory Pasadena Calif
SEAFLOOR AUTOMATED LANDER TECHNOLOGY (SALT) (FORMERLY THE HIGH ENERGY BENTHIC BOUNDARY LAYER EXPERIMENT--HEBBLE)
Kent Frewing 213-577-9309

This activity will broaden the FY-79 and FY-80 High Energy Benthic Boundary Layer Experiment (HEBBLE) task into a more general effort aimed at developing Seafloor Automated Lander Technology (SALT). The objectives of the activity are twofold: (1) to apply NASA's institutional expertise in system design, engineering and system integration to problems in oceanography and to transfer aerospace technology to the oceanographic community and its sponsors; and (2) to understand the physical and biological processes at selected dynamically active sites in

the benthic boundary layer (and their interaction with the seabed) to determine their rates and predict their behavior. In FY-79 and FY-80 emphasis was on program planning and preliminary design of the HEBBLE central lander. In FY-81 emphasis will be on developing specific hardware items carrying out tests and designing equipment that is required for the system design of seafloor landers. System engineering will be performed on an instrumented seafloor flume, a precursor to a HEBBLE central lander. The flume will be a cooperative effort with the Woods Hole Oceanographic Institution (WHOI) and co-sponsorship is being sought from the Office of Naval Research (ONR). Specific seafloor lander technology that will be studied as part of this RTOP will include: (1) observation of how seafloor lander footpads affect the seafloor and BBL flow; (2) design and fabrication of a conditional sampler; (3) a study of potential energy sources for a long term seafloor lander; and (4) a study of the feasibility of using a satellite link to obtain data from a seafloor lander.

Advanced Communications Research

W81-70384 **650-20-16**
Lewis Research Center Cleveland Ohio
30/20 GHZ WIDEBAND SYSTEM DEFINITION
J R Ramler 216-433-4000
(650-60-18)

30/20 GHz program operational studies are required to provide a continuing focus for NASA technology development and to help insure the relevancy of potential demonstration satellite systems. The objective of the studies are (1) to assess and characterize the technical and economic requirements of potential operational satellite communications systems utilizing Ka-band and (2) to identify and define potentially viable concepts. The approach incorporated in these studies involves an assessment of markets for satellite supplied communications services, definition studies of advanced satellite systems to meet the predicted market demands and network design/cost modeling to determine optimum approaches to implementing these advanced systems into existing communications networks. In some cases these efforts will update, refine and extend previous Ka-band market and advanced systems studies.

W81-70385 **650-60-18**
Lewis Research Center Cleveland Ohio
GHZ WIDEBAND COMMUNICATIONS SATELLITE PROJECT DEFINITION
R T Gedney 216-433-4000
(650-60-21 650-60-23 650-20-16 650-60-20 650-60-22)

The objective is to plan for the demonstration phase of the 30/20 GHz wideband communications satellite program. The demonstration phase (phase III) will be for the procurement and experiment operation of a 30/20 GHz demonstration system, including flight spacecraft and ground terminals for trunking customer promises and emergency communications services. During the current phase (phase II) conducted in FY-80 and FY-81, preparations will be made for the new project. In FY-82, the mission level requirements will be defined for the demonstration system. The experiment capability required by the demonstration system will be defined, required memoranda of agreement for mission operations will be prepared, and the phase III request for proposals will be prepared. Coordination and interaction will be provided with representatives of the service carriers to determine the system functional requirements and experiment requirements. Communication system supplier studies (phase II) will each provide demonstration system design data, experiment plans, system development plans, technology development plans and a mission level requirements document. The contractor generated requirements documents will be synthesized by NASA into a mission requirements document for the phase III request for proposal.

W81-70386 **650-60-20**
Lewis Research Center Cleveland Ohio
30/20 GHZ SPACECRAFT MULTIBEAM ANTENNA TECHNOLOGY
R T Gedney 216-433-4000
(650-60-23 650-60-18 650-60-21 650-60-22)

The objective of this RTOP is to design, fabricate and test proof of concept (POC) model antennas for 30/20 GHz wideband

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

communication satellites. This effort will perform an investigation to evaluate and compare operational multibeam antenna system design concepts for a communications satellite select the best concept thereof and develop a detailed design for the best concept antenna system. Emphasis will be placed on the system design concepts and technologies that maximize RF performance and degree of frequency reuse and minimize the complexity, volume weight, deployment techniques and costs. The effort will breadboard and test critical technology components and will design, fabricate and test a proof of concept model to demonstrate technology feasibility. This technology will provide design data for flight hardware for 30/20 GHz demonstration systems to be flown in 1986 and 1988 and to evaluate antenna hardware elements needed for approaches that will be appropriate for operational satellites in the 1990s. The antenna approach will be capable of providing up to eighteen (18) fixed spot beams for trunking application between major cities in addition to up to six (6) scanning beams for customer premise services. Physical characteristics for the antenna system will permit packaging within the Shuttle vehicle envelopes.

W81-70387 **650-60-21**

Lewis Research Center Cleveland Ohio

SATELLITE SWITCHING AND PROCESSING SYSTEMS

R T Gedney 216-433-6209

(650-60-23 650-60-18 650-60-20 650-60-22)

The objective of this effort is to develop the switching technology for the routing of signals (traffic) aboard multibeam multichannel 30/20 GHz wide band communications satellites. Dual contracts for the design, fabrication and testing of proof of concept (POC) models will be let in CY-80 in each of the following areas of satellite switching and processing: intermediate frequency (IF) switch matrices for wide-band TDMA trunking applications; switch matrices and filters for FDMA customer premise service (CPS) application; and baseband switching and processing for TDMA CPS application. These efforts which are planned for completion in CY-82 will provide proof of concept hardware and documentation, technology readiness verification and design data for demonstration flights in 1986 and 1988. The objective of these flights is to demonstrate the technology for Ka band operational systems which will be implemented in the 1990s.

W81-70388 **650-60-22**

Lewis Research Center Cleveland Ohio

COMMUNICATIONS SYSTEM COMPONENTS

R T Gedney 216-433-6209

The objective of this RTOP is to perform supporting research and technology development in the area of spacecraft transponders and transponder components including power amplifiers (tube and solid state), low noise receivers and other transponder components identified as needed in 30/20 GHz communications satellites system studies and to determine the ranges of applicability of various component design configurations as functions of performance requirements and physical characteristics e.g. volume, weight, power. By means of principally a contractual program this RTOP will develop analysis and synthesis techniques for the above satellite components, apply the developed techniques to determine the basic characteristics of components meeting specified requirements, fabricate experimental components, test and evaluate fabricated components, perform proof of concept tests in house on a breadboard transponder for a selected approach using developed components in late FY-82.

W81-70389 **650-60-23**

Lewis Research Center Cleveland Ohio

COMMUNICATIONS SYSTEMS BREADBOARD

R T Gedney 216-444-4000

(650-60-18 650-60-20 650-60-21 650-60-22)

The objective of this RTOP is to design and develop a breadboard model of a 30/20 GHz communications transponder to be used for compatibility and performance testing of subsystem developed for the 30/20 GHz Communications Program. The transponder with appropriate input and output signals will simulate earth terminal to satellite to earth terminal communications links. In-house design of a 30/20 GHz interim transponder utilizing

state of the art components was completed in FY-80 and major components were purchased. Testing and familiarization with the interim transponder will commence upon completion of fabrication of the transponder lab. A proof of concept test transponder will be designed and fabricated which incorporates the technology development program POC subsystem hardware. A simulation of the test transponder and POC subsystem hardware will be developed to predict test results and aid in test analysis. System testing will be conducted to define the characteristics of both the complete transponder as well as individual POC subsystems. The transponder will be updated as required to provide a test bed for analysis and trouble shooting of flight transponders.

Data Management

W81-70390

656-13-10

Jet Propulsion Laboratory Pasadena Calif

OSTA DATA SYSTEMS STANDARDS AND GUIDELINES

J T Renfrow 213-354-9065

(656-13-40 656-13-60)

The objectives of this activity are to work cooperatively with Goddard Space Flight Center to achieve the definition of the standards requirements for OSTA programs and ADS pilots by interfacing with program representatives at Headquarters and other Centers and the Oceanic Pilot project within JPL and to perform a major role in the design of specific data system standards to coordinate with similar standards activities outside NASA in particular to foster future multi-Agency and international cooperative use of standardized Applications data to assist GSFC in the establishment of a standards implementation mechanism and finally to coordinate with the ADS Oceanic Pilot Project to implement the standards and guidelines. These objectives will be pursued through the establishment of an OSTA Associate Standards Office at JPL staffed with data systems engineering experts which will work jointly with its counterpart at GSFC to achieve the definition of appropriate standards.

W81-70391

656-13-10

Goddard Space Flight Center Greenbelt Md

OSTA/ADS DATA SYSTEMS STANDARDS AND GUIDELINES PROGRAM

Gerald Knaup 301-344-6034

The aim of this RTOP is to establish a program to provide effective standards and guidelines for OSTA/ADS data and data systems. The general approach is to define and develop standards and guidelines for data catalogs, data set formats and structures, data system interfaces, systems interconnection and where practical, software obtain requirements by analyzing the data systems needs of the ADS pilots and key OSTA programs such as UARS, NOSS and AgRISTARS. In cooperation with the appropriate project or study offices, specify, evaluate and document key standards and guidelines in a controlled handbook series, develop these standards and guidelines by identifying and building on the best current work and approaches such as the climate database catalog, the Landsat image format family, the ISO/ANSI/NBS computer network protocol standards programs and FIPS software documentation guidelines, establish mechanisms to maintain the handbooks and provide for their dissemination, review, evaluation, use and evolution and finally to coordinate standards and guidelines with similar activities within and outside of NASA such as OAST NEEDS, OSTDS aerospace data systems standards, NOAA, NBS, ANSI and ISO. Coordination among centers is particularly important.

W81-70392

656-13-20

Goddard Space Flight Center Greenbelt Md

FULL SCALE APPLICATIONS DATA SERVICE (ADS) PLANNING STUDIES

Gerald Knaup 301-344-6034

This project will continue planning activities related to ADS development. The objectives are (1) develop an approved statement of goals, objectives and requirements for ADS from existing and planned OSTA and other programs, key programs of other agencies and findings from ADS pilot systems studies; (2) define a concept for orderly implementation of a full-scale integrated ADS; (3) prepare a 10-year plan and supporting analyses to focus and direct ADS development. The approach will be to initiate studies of ADS documentation and key OSTA

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

programs and identify requirements goals and objectives establish interfaces with NASA Headquarters NASA Centers and other external programs and integrate requirements and objectives into ADS planning define short and long range goals and objectives of ADS and prepare plans requirements schedules work breakdown structures and cost estimates for ADS development define the concept for full-scale ADS implementation and prepare a 10-year plan for total ADS Program and update the plan upon pilot systems study results

W81-70393 **656-13-30**
Goddard Space Flight Center Greenbelt Md
APPLICATIONS DATA SERVICE (ADS) ATMOSPHERIC PILOT SYSTEM

Gerald Knaup 301-344-6034

This program will define implement and evaluate an evolutionary ADS pilot system in the atmospheres discipline and Provide (1) an ADS-type network useful for selected OSTA-related Atmospheric users/programs (2) a test bed for the ADS Program to demonstrate and evaluate alternative standards and advanced data handling concepts and (3) a base from which a future full-scale ADS can evolve. The approach will be to continue and extend FY-80 initiated cooperative efforts with SSRP VAS Demo Climate Research and UARS atmospheric discipline programs to explore evaluate and demonstrate improved capabilities for linking data users and data producers and to utilize and augment existing atmospheric data systems such as the AOIPS and GSFC and Wisconsin VAS Processors to serve as test beds to develop and demonstrate ADS concepts. Emphasis will be given to (1) data cataloging data access and data delivery capabilities to improve user access to atmospheric related data (2) and techniques such as SNAP for interconnecting data systems and data bases to improve atmospheric data sharing capabilities

W81-70394 **656-13-40**
Jet Propulsion Laboratory Pasadena Calif
ADS OCEANIC PILOT SYSTEM PROJECT

E A Gardner 213-354-9028
(656-45-02 656-31-02 656-13-60)

The objectives of this activity are to (1) evaluate design and implement the appropriate computer and information technologies standards and applicable products for an oceanic information pilot system (2) develop a thorough understanding of the information systems needs of the OSTA oceanic research community by demonstrating developed capabilities and (3) coordinate phases of the Oceanic Pilot System development with the other pilot systems related NASA End to End Data System (NEEDS) efforts and the Applications Data Service (ADS) planning studies. These objectives will be pursued through the design development and operation of the Oceanic Pilot System. This system will provide selected researchers in the oceans remote-sensing community with computerized access to satellite and conventional data sets. It will offer users state-of-the-art facilities for data communications management cataloging remote access data base sharing and networking. This pilot system possessing many of the attributes of the OSTA Data System/Applications Data Service (ADS) will serve as a test-bed for the development and analysis of key information system capabilities. This effort will be coordinated with the activities of the Oceans Data Utilization Study (RTOP 656-13-60) and will act as test-bed for that study.

W81-70395 **656-13-60**
Goddard Space Flight Center Greenbelt Md
OCEANIC DATA UTILIZATION SYSTEM STUDY

David Howell 301-344-9041

This program will investigate user requirements for the ingest manipulation management display integration and analysis of data from ocean monitoring systems and make recommendations for needed capabilities to meet those requirements. A study will be initiated to investigate and evaluate user requirements produced by the ICEX NOSS and TOPEX Science Working Groups. Alternative data systems concepts will be defined based on user requirements available facilities and Goddard experience in development of capabilities such as AOIPS for ingest management analysis and display of applications data. Re-

commended approaches for Oceanic Data Utilization System development will take full advantage of Goddard work in support of weather and climate ADS and related programs

W81-70396 **656-13-70**
Jet Propulsion Laboratory Pasadena Calif
ADS PILOT GEOSCIENCES INFORMATION NETWORK DEVELOPMENT

J R Huning 213-354-9358

(656-13-40 656-13-02 656-33-01)

The purpose of this RTOP is to test the Applications Data Services (ADS) concept of a common catalog for available data by design of a pilot system for the distributed geosciences data bases. The three objectives of this activity for FY-81 are to (1) define and analyze methods currently used in the management of distributed data catalogs in the geosciences (2) define user requirements for access to distributed data bases in the geosciences community and (3) design a pilot Geosciences Information Network (GIN) for exchange of catalog information that points to geosciences data. The objectives will be accomplished by performing three major tasks. The first task is identification of applicable OSTA/NASA and related data bases for the geosciences and the preparation of a coordinated and prioritized summary for each data base including current status location and access method. The second task is the performance and documentation of a user requirements analysis. This task builds upon the FY-80 JPL study in the crustal dynamics area and expands consideration of data bases to the related and significantly larger geosciences disciplines. The third task is the design of a pilot GIN system with the data bases to remain in the existing wide variety of hardware used for data management and under control of the present data base managers.

W81-70397 **656-31-02**
Jet Propulsion Laboratory Pasadena Calif
APPLICATIONS DATA BASE MANAGEMENT SYSTEM (ADBMS)

Guy M Lohman 213-577-9291
(656-13-40 520-73-05)

The objective of this study is to develop the functional requirements for data management operations that are common to most users of OSTA and related data bases and to procure or develop the software necessary to meet those requirements. The functional requirements will evolve from successive in-depth analyses of representative existing data bases their current data management systems users and those missions or other sources who supply the data. Primary emphasis will be upon the tools needed by users to access and manipulate data. Data collection from available literature and interviews with data managers users and data suppliers will be analyzed to determine what functions should be performed by a generalized data base management system (DBMS). An assessment of the characteristics of current and projected data types will determine other functional requirements upon the DBMS. Finally existing standards relevant to an OSTA DBMS will be compiled and evaluated for possible inclusion into the requirements. The results will be reviewed by two workshops one early in the fiscal year to review preliminary results and the methodology used the second late in the fiscal year to review final results and a plan for development and implementation. Then in FY-80 a feasibility analysis will determine the most cost effective source of each DBMS component followed by a period of procurement and/or development of each component. Finally the components will be integrated and implemented for testing in a distributed pilot configuration.

W81-70398 **656-33-01**
Jet Propulsion Laboratory Pasadena Calif
AUTOMATED MOSAICKING FOR GEOCODED DATA BASES

Albert L Zobrist 213-354-3237

The goals of the tasks described herein include (1) reducing the cost of performing digital geometric transformation and mosaicking (2) developing transportable procedures for producing computer mosaics from digital frames of Landsat and other sensors processed by the GSFC Master Data Processor and (3) developing transportable general purpose mosaicking and geocoded data

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

base interface software designed to provide multi-sensor and multi-temporal registration of multiple scenes at minimal cost. Such procedures should permit Landsat digital users to no longer be constrained by the framing convention used for Landsat and potentially achieve greater economies of scale in thematic mapping and enhanced image interpretation by extending their analysis over much larger areas. Moreover, they should facilitate the spatial integration of other satellite imaging systems having various pixel sizes, orbit inclination and image swath areas (e.g. HCMM Seasat SAR). Finally the integration of previously developed software and procedures to register and compare image and graphical files will provide the means to automatically register non-NASA geocoded data bases with imaging data thereby bringing NASA data into the mainstream of data processing at minimal cost. The specific objectives of this proposed research are oriented toward the development of algorithms and associated software modules and systems integration to (1) extend the MDP temporal registration and geometric correction to multiple-frame Landsat digital mosaics at standard map projections (2) achieve an automated geobase (e.g. nominal/ordinal) interface with the MDP output of Landsat digital images (3) the software and procedures developed to selected test cases. The test cases include ongoing research programs being undertaken by the Image Processing Laboratory thereby capitalizing on the current results for comparison with the developed technology.

W81-70399 **656-45-02**

Jet Propulsion Laboratory Pasadena Calif
REGISTRATION OF RADAR AND OTHER DATA

Richard J. Blackwell 213-354-5677
(656-13-01)

The objectives of this task are to develop a series of data and image processing techniques which will permit the registration merging, overlaying and display of remotely sensed and in-situ oceanic data. The techniques developed will be tested and evaluated by the oceans user community with the Oceanic Data Utilization System (ODUS). The ultimate goal of this task is to provide the ocean science data user the methods and means to assemble multi-layered data sets of oceanic data. The data sets may consist of sensor outputs from a number of ocean viewing satellites such as Seasat, NIMBUS-7, TIROS and the NOAA series. Also included will be the ability to include in-situ information as another information component. The results of this technology development task will be evaluated by the ocean science data user community in cooperation with the ADS Oceanic Pilot System Project. A series of studies limited to specific goals will be planned and phased. The studies will be directed toward the development of technologies and methodologies which will enable the registration of multi-sensor satellite data. These data may represent overpasses at different times from the same satellite or from different satellites. The procedure to be followed after data acquisition and establishment of the characteristics of sensors will be largely (1) geolocation of the data (2) selection of scale (3) alteration of data to selected scale (4) geometric transformation and registration to a planimetric base and (5) application of existing techniques such as differencing to characterize accuracy.

W81-70400 **656-62-01**

Jet Propulsion Laboratory Pasadena Calif
SYNTHETIC APERTURE RADAR PROCESSOR

Raymond G. Piereson 213-354-3322
(677-36-01 506-61-15)

The general objective of this RTOP is to develop high-throughput synthetic aperture radar (SAR) data processor technology to meet the requirements of future space missions. This will be accomplished as follows: (1) the hardware and software of the interim digital processor will be upgraded. This will increase the throughput rate by approximately a factor of five. This will enable a 100 Km x 100 Km Seasat image exhibiting 25 m resolution at four looks to be processed in approximately two hours. This upgrade will be completed during FY-81. (2) an advanced digital SAR processor (ADSP) utilizing the technology expected to be available in the mid 1980's will be developed. A ground based engineering model ADSP will be developed by the end of FY-85. This processor will have the capability to

process Seasat SAR data at the real-time acquisition rate. (3) research into processor architectures, adaptive process control techniques and SAR processing algorithms will be performed. This work will enable further advances in SAR processors and enable an increase in the amount of information obtained from SAR imagery. Tasks 1 and 3 will be performed in-house at JPL. Task 2 will be performed by contractors with direction from JPL.

Regional Application Transfer Activities

W81-70401 **663-90-03**

Jet Propulsion Laboratory Pasadena Calif

COMMERCIAL FISHERIES OCEAN FORECAST DEMONSTRATION

D R Montgomery 213-354-2339

This activity will broaden and extend the fisheries support experiment in the Seasat Commercial Demonstration Project by developing new fisheries products based upon remote ocean sensing and then demonstrating their utility through real-time broadcast to fishermen at sea. The objectives are: (1) to collect Northeastern Pacific satellite data which are of interest to fisheries (2) develop new (tailored) fisheries products which merge satellite information and conventional numerical analyses/forecasts of environmental parameters (3) distribute these products to fishermen using the existing Satellite Data Distribution System (SDDS) and cooperating radio broadcast stations and (4) affect technology transfer back to NASA in the areas of sensor accuracy, optimum orbital configuration, data processing, product transmission/display and economic benefits.

Geodynamics

W81-70402 **676-10-10**

Goddard Space Flight Center Greenbelt Md

REGIONAL CRUSTAL DEFORMATION MODELING

R J Allenby 301-344-6523
(677-45-01 676-30-01)

The objective of this RTOP is to conduct studies of geophysical models of crustal deformation of geodetic data obtained under NASA's Crustal Dynamics Project and to determine types and accuracies of other ground-based measurements and ancillary data significant to interpreting regional tectonic processes. This RTOP will develop models of earthquake mechanisms, fault motions and regional tectonics in active seismic areas, interpret and improve these models using VLBI and laser ranging measurements as they become available, and improve our understanding of the earth's rheology and spatial differences of seismic energy release from region to region. Specific areas of study include the eastern U.S. with emphasis on the central and southern Appalachians and the Basin and Range/San Andreas Fault zone relationship.

W81-70403 **676-30-01**

Goddard Space Flight Center Greenbelt Md

GLOBAL EARTH DYNAMICS AND STRUCTURE

D E Smith 301-344-8555

The objective of this RTOP is to improve our understanding and knowledge of the dynamics of the earth by development of models of polar motion and earth rotation, global plate motion, mantle convection, plate driving mechanisms, the dynamics of the core and earth tides, and to improve our knowledge and understanding of the global structure of the earth, its interior properties, its crustal magnetization, the gravity field and its anomalies, and the evolution of the lithosphere and crust. Theoretical and numerical studies will be conducted of the density structure, stress and rheology of the mantle and properties of the lithosphere based on gravity, altimetry, tracking and supporting geophysical data. The dynamic processes at convergent plate boundaries will be modeled and investigated and also the early evolution of the crust resulting from major impact bombardment. In addition, the tidal perturbations of satellites will be used for the estimation of earth and ocean tidal amplitudes and phases. The RTOP addresses the following major problems: (1) the understanding of the processes and mechanisms of plate motion and mantle convection; (2) the properties and evolution of the lithosphere; and (3) the deformation of the earth by tidal forces.

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

W81-70404

Goddard Space Flight Center Greenbelt Md

GEOPOTENTIAL FIELD MODELS

D E Smith 301-344-8555

The objectives of this RTOP are the development of gravity and magnetic field models and associated analytical methods data analysis techniques and supporting software systems From the analysis of satellite tracking data in conjunction with satellite altimetry and surface measurement data models of the earth's gravitation field shape and size will be derived Global models in both gravity anomaly and geoid height representation will be developed down to wavelengths of about 100 km More accurate and reliable field models of the earth's main magnetic field and its secular variation will be derived from satellite and surface data and techniques developed for separating the field according to its source The development of the software systems to support the gravity and magnetic field modeling activities will be continued This RTOP supports the following program areas (1) the development of models of the earth's interior structure (2) the development of lithospheric models (3) the determination of the ocean geoid for oceanography (4) the investigation of core motions and dynamics and (5) the use of magnetic and gravity data for resource assessment

676-40-01

W81-70408

Jet Propulsion Laboratory Pasadena Calif

LASER/VLBI PROPAGATION MEDIUM ANALYSIS

G M Resch 213-354-4786

The objective of this RTOP is to determine the total atmospheric delay (both dry and wet components) with sub-centimeter accuracy This information will be used to assess the effects of gradients and fluctuations in the refractive index on the possible centimeter level performance of laser ranging and VLBI systems The measurements of the wet delay will be used to evaluate the accuracy of the water vapor radiometer technique We will design construct and test a three-color ranging device (two optical signals and one microwave signal) that we can use to range to an aircraft If the aircraft is at an altitude of 6km or more we should be able to measure 95% of the wet delay and over 50% of the dry delay As the aircraft flies various patterns around and over the ranging site we should be able to measure horizontal gradients and their temporal stability We will simultaneously look along the line of sight to the aircraft with a water vapor radiometer and make an independent estimate of the total water vapor content In addition we will test the ability of the WVR to track fluctuations of water vapor and provide a calibration to an interferometer by taking two WVRs to the site of the very large array Real-time comparisons will be made between water vapor and interferometer phase on baselines up to 21 km The instrumentation in both laser ranging and VLBI systems appears capable of cm level performance However system accuracy will be limited by other systematic error sources such as uncalibrated tropospheric delay It is imperative to evaluate the magnitude of these tropospheric effects and to evaluate the techniques that we might use to reduce them

676-59-37

W81-70405

Goddard Space Flight Center Greenbelt Md

ADVANCED GEODYNAMICS STUDIES

W D Kahn 301-344-8554

The objectives of this RTOP are (1) to define develop and evaluate design strategy for an airborne laser ranging system suitable for regional monitoring of crustal deformation and other earth dynamics phenomena and (2) to study and define instrumentation orbit geometry and coverage mission life-time for monitoring the secular variation and decay of the earth's main magnetic field Studies will be made to determine measurement accuracy rate and geometry requirements for an airborne laser ranging to ground emplaced retro-reflectors for detection and monitoring of small earth surface motions Alternative near-earth magnetic field missions will be evaluated Emphasis is to be placed on determining a mission profile which optimizes new information regarding the earth's main magnetic field

676-59-30

W81-70409

676-59-41

Marshall Space Flight Center Huntsville Ala

SHUTTLE TIME AND FREQUENCY TRANSFER EXPERIMENT (STIFT)

R Decher 205-453-5130

The objective of this RTOP is to define a demonstration experiment using a hydrogen maser clock onboard the shuttle for world wide time and frequency transfer with accuracies in the nanosecond range or below Microwave and laser signals will be transmitted between the space vehicle and a ground station to compare the space clock with a ground clock Other organizations participating in the study include USNO NBS SAO and the University of Maryland

W81-70406

676-59-33

Marshall Space Flight Center Huntsville Ala

SUPERCONDUCTING GRAVITY GRADIOMETER

E W Urban 205-453-5132

The objective of this RTOP is to demonstrate the feasibility of a three-axis superconducting gravity gradiometer for space flight that is capable of measuring gravity gradients along three mutually perpendicular axes with a sensitivity of 0.001 EU or better A single axis unit will be completed and tested and a three axis engineering unit will be designed fabricated tested and refurbished for a possible Shuttle test flight

W81-70407

676-59-35

Goddard Space Flight Center Greenbelt Md

LASER/VLBI PROPAGATION MEDIUM ANALYSIS

J B Abshire 301-344-8948

(506-61-56)

The overall objective of this RTOP is to evaluate the accuracy of existing atmospheric models used with laser ranging systems It represents the Goddard effort of a joint Goddard/JPL program to analyze propagation medium effects in laser and VLBI systems The specific program objectives for this RTOP are as follows (1) develop instrumentation techniques for atmospheric refractivity measurements (2) carry out extensive tests over horizontal paths to validate the accuracy of the measurement system and (3) carry out ranging tests over slant paths to aircraft to evaluate the accuracy of models The technical approach for this effort is (1) to develop a multiwavelength ranging system to measure integrated air density along the ranging path (2) evaluate the use of highly sensitive angle tracking devices as an independent technique to measure atmospheric refraction gradients and (3) use data obtained from approaches one and two to measure the accuracies of existing atmospheric models

W81-70410

677-21-06

National Space Technology Labs Bay Saint Louis Miss

INTEGRATION OF VIS-IR-NW DATA

S T Wu 601-688-3830

The basic objective is to evaluate the results of having combined data acquired with multispectral scanners and synthetic aperture imaging radars relative to deriving improved land resource inventory information The established approach as outlined below will be continued with the goal of completing the associated analysis evaluation and documentation by the end of FY-81 The objectives are to (1) derive land resources information from multispectral scanner (MSS) digital data acquired over a variety of terrain types by Landsat (2) derive land resources information from synthetic aperture radar digital data acquired by Seasat and aircraft over the same test sites for which Landsat data was processed (3) derive land resources information from a digital data set produced by merging synthetic aperture radar (SAR) data and Landsat MSS data used for (1) and (2) and (4) evaluate the results with respect to the number types and accuracy of land cover/vegetation classes derived by processing SAR data and Landsat MSS data independently and compare these results with those produced from processing the merged SAR-MSS digital data sets

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS**W81-70411**

National Space Technology Labs Bay Saint Louis Miss
SURFACE MINE REHABILITATION INVENTORY AND MONITORING

Dale Quattrochi 601-688-3830
(677-21-06)

The project objective is to determine and analyze what information pertinent to the inventory planning and monitoring of surface mine rehabilitation can be derived from spacecraft-acquired data. An evaluation will be made of how the optimum sensor system or systems spectral and spatial resolution, and season can be combined with a geographic data base to identify and monitor surface mining reclamation activities. The technical approach will be to analyze data acquired over abandoned active or recently rehabilitated surface mines within study sites in eastern and western Kentucky. Data collected by existing spacecraft sensor systems will be assessed in conjunction with data obtained through simulating spectral, spatial, and radiometric properties of future spacecraft sensor systems. Particular emphasis will be placed on analyzing the improved resolution capabilities of the Landsat-D Thematic Mapper relative to the Landsat Multispectral Scanner. All of the remotely sensed data for this research will ultimately be evaluated on how much information each sensor contributes and how the integration of the various sources of data through a geographic information system enhances the utility of remotely sensed data for surface mine rehabilitation inventory and monitoring.

677-21-20

Ames Research Center Moffett Field Calif
ALASKA WETLANDS DELINEATION PROGRAM

D E Wilson 415-965-5897

An RTOP is proposed to develop and test several techniques of Landsat digital and computer-aided visual analysis for distinguishing wetlands from non-wetlands cover types in Alaska. Test sites representing various physiographic regions of Alaska will be studied in order to develop a wetlands delineation model that will apply so far as is possible over the majority of the State. The project objectives will be met through the following approach. Initially an assessment of agency needs concerning wetlands information will be conducted along with derivation of a uniform definition of wetlands. Physiographically different test sites will then be chosen and ground-truthed. To analyze these sites several techniques will initially be employed. Among these are use of multi date imagery, band ratioing, stratification and ancillary data. It is anticipated that at least two of the three following Landsat data systems will be employed in this effort: ARPA/NET/EDITOR, IDIMS, VICAR/IBIS. All results and recommendations forthcoming will be evaluated and tested in the broadest environment to determine extent of applicability. Comparisons will be made with results of integrated terrain unit mapping in the Susitna River Valley.

W81-70412**677-21-22**

Ames Research Center Moffett Field Calif
REMOTELY-SENSED ELECTROMAGNETIC CHARACTERISTICS OF SNOW AND SOIL MOISTURE

W I Lindor 415-965-5538

The long-range objective of this activity is the development of microwave remote sensing techniques for the measurement of the areal extent, depth, density and wetness of snowpacks employing surface systems, aircraft and satellite vehicles. Such information is needed to assess snowpack mass and runoff regimes for flood forecasting. Immediate objectives of the RTOP include investigation of the electromagnetic characteristics of natural snowpacks (dielectric constant, attenuation and layering), radar backscatter properties and development of surface systems to provide ground-truth data. The surface systems have the additional objectives of providing data for assessment of watershed resources on a time progressive basis operated automatically in DCP installations including measurement of soil moisture utilizing microwave techniques. The approach consists of measuring the phase shift and attenuation as functions of frequency in the range of 2 to 18 GHz for in-situ snow and for samples. Radar backscatter is investigated as functions of frequency, angle of incidence, polarization and snow layering. Calibration involves

use of dry snow to which known amounts of water have been added. Soil wetness is investigated by measurement of phase shift and attenuation for in-situ assemblies and for samples.

W81-70414

Jet Propulsion Laboratory Pasadena Calif
RADAR SPECTROMETER
W E Brown Jr 213-354-2110

The objective of this RTOP is to develop a very wide band radar system to measure surface radar backscatter as a function of wavelength. The long-range objective is to complete a system that covers the radar wavelength range of 30 cm to 3 mm (frequency range 1 GHz to 100 GHz). The short-range objective is to cover the range 15 cm to 1.7 cm (2 to 18 GHz). In FY-80 this RTOP will complete the development of the 2 GHz to 18 GHz system and conduct engineering testing. In FY-81 it will augment the system with modulation and 1 watt CW traveling wave tubes as necessary, conduct field tests with users involved with geology and agricultural experiments to evaluate the system performance and carry out a system design study to mount the spectrometer on a helicopter to generate functional specifications.

W81-70415

Goddard Space Flight Center Greenbelt Md
GRAVITY FIELD SURVEY MISSION (GRAVSAT) PHASE B STUDIES

Samuel Bergeson-Willis 301-344-8566

The objective of this RTOP is to become fully prepared for a new start for the GRAVSAT mission in FY-82 from an engineering, scientific, fiscal and management point of view. Mission objectives for GRAVSAT are the determination of gravity with an accuracy of 1 milligal in 1 deg x 1 deg squares globally and the determination of geoid height to 10 cm for wavelengths between 100 km and 3000 km. A definition phase study for GRAVSAT will be conducted. Specific tasks to be accomplished and milestones are to define subsystems in sufficient detail to insure their technological readiness and to continue the development of a brass board of the Satellite-to-Satellite Doppler Tracking System to demonstrate technology readiness for GRAVSAT (September 1981).

W81-70416

Goddard Space Flight Center Greenbelt Md
DEMONSTRATION FLIGHT SYSTEM AND OPERATIONAL LAND OBSERVING SYSTEM (OLOS)

Enrico P Mercanti 301-344-7889

The objective of this RTOP is to support the National Oceanic and Atmospheric Administration (NOAA) in the definition and development of the demonstration flight system and the Operational Land Observing System (OLOS) which was mandated by Presidential Directive PD/NSC-54 in November 1979. This RTOP will perform Phase A mission tradeoff studies for the demonstration flight system and the OLOS, conduct technical and feasibility analyses, establish schedules, estimate costs and assess risks pertaining to alternative space and ground segment configurations. All tasks will be performed in compliance with interagency-stipulated user data product requirements and in close coordination with NOAA, the R&D User Working Group and the OLOS Operational User Working Group.

W81-70417

Goddard Space Flight Center Greenbelt Md
PHASE B STUDIES - LANDSAT SOLID-STATE SENSOR (LS3)

Leslie L Thompson 301-344-8107
(677-37-01)

The objective of this RTOP is to develop detailed design options and set of specifications for potential instruments that provide both a demonstration of the advanced technology associated with multi-spectral linear arrays (MLA) and the prototype of the potential sensor for the Operational Land Observing System. Based on the definition of user requirements developed by an R&D User Working Group and the Operational User Working Group and the results of FY-80 MLA Phase A studies, GSFC will initiate competitive Phase B studies with two

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

contractors in parallel with the contractor studies GSFC will perform parametric systems analyses to validate the relative merits of each of the contracted studies. A detailed plan and RFP for Phase C/D will be prepared. This RTOP supports the following programs (1) Landsat (2) shuttle payload, and (3) Operational Land Observing System. These in turn support the following objectives (1) agricultural and mineral resources (2) environment and (3) disaster assessment

W81-70418 677-41-02
Jet Propulsion Laboratory Pasadena Calif
NASA/GEOSAT TEST CASE STUDY
Michael J Abrams 213-354-6927
(677-41-03 677-41-04)

The primary objectives are to (1) demonstrate that useful information for geologic mapping can be derived from currently available remote sensing techniques (2) evaluate the utility of current remote sensing technology for mineral/hydrocarbon exploration and (3) develop recommendation for the design of future aircraft/spacecraft remote sensing systems that could supply data to meet the requirements of exploration geologists. The approach is to perform the following activities in conjunction with the Geosat Committee Inc (1) complete the FY80 project involving selected test sites in regions of known uranium copper and hydrocarbon occurrences and produce a final report (2) follow-on uranium study to examine regional alteration in the Glen Canyon Series rocks associated with uranium occurrences local alteration associated with uranium deposits such as at Temple Mtn Utah and determine the correlation (if any) with regional alteration and spectral and mineralogical characteristics of an exhaustive suite of rock sample from worldwide uranium deposits will be developed (3) a test case project will be established for volcanogenic massive sulfide deposits Two phases will be started in parallel one to study deposits in the US and the other in Australia. Sedimentary basins in the US will be studied for regional and local structural and lithologic control on hydrocarbon formation migration and emplacement. Other commodities and/or deposits will be identified for study based on economic factors and national needs. For each a test case study will be initiated in conjunction with Geosat members and personnel from academia and other government agencies similar to the projects already ongoing for copper uranium and hydrocarbons

W81-70419 677-41-04
Jet Propulsion Laboratory Pasadena Calif
ROCK TYPE/MICROWAVE TECHNIQUES (IMAGING RADAR GEOLOGY)
Charles Elachi 213-354-5673

The Seasat SAR was the first step in developing our capability to observe the Earth's surface with an active microwave sensor from space. Other experiments will be conducted in 1981 (the Shuttle Imaging Radar-A Sir-A). In order to be able to analyze the data from these experiments and plan future ones it is essential to understand the radar signature of surface features as a function of the radar parameters (frequency observation geometry polarization) and the interaction of the radar waves with the surface. This proposal is directed toward these objectives. The proposal covers all the research effort at JPL in the area of radar geology for the three-year period of FY-81 FY-83. It represents the efforts of a team of eleven researchers who will be addressing different aspects of the radar geology activity with the common objective of understanding the information in radar images and developing techniques to use them in conjunction with other remote sensing data to further our understanding of the Earth's surface geology

W81-70420 677-41-08
Jet Propulsion Laboratory Pasadena Calif
HIGH SPECTRAL RESOLUTION REMOTE SENSING
Anne B Kahle 213-354-7265
(677-41-03 677-42-01)

The research objectives are to complete the computer and other analyses of high spectral resolution aircraft data. The analysis will be aimed primarily at extracting information from the new high resolution data in 1.4 micrometer to 2.5 micrometer region. The information sought is (1) characteristics of the clay and

carbonate bands in the 2.0 micrometer to 2.5 micrometer region (2) properties of vegetation canopies in the 1.1 micrometer to 2.5 micrometer region (3) optimum spectral bands in these regions and (4) the noise problems in the IR region. Reference spectra of known rock sample will be taken in the laboratory. These curves will be compared with the field data using various pattern recognition techniques. Many of these techniques will be tested during the research. Vegetation spectra will be analyzed using waveform analysis methods developed to detect spectral differences among the data. The differences sought in particular are those that are associated with mineral deposits. Various spectral bands will be simulated in the aircraft data and tested for optimum width spectral position and number of bands required for scanner survey applications. The aircraft field data will be put into the band models to evaluate ground-induced noise effects that will be found in scanner data

W81-70421 677-41-09
Jet Propulsion Laboratory Pasadena Calif
GEOLOGICAL MAPPING KILAUEA CALDERA STRATIGRAPHY
Michael J Abrams 213-354-6927

The objective of this proposal is to define and characterize the stratigraphic units in the wall of Kilauea Caldera Hawaii. This information is important to help decipher the prehistoric eruptive history of one of the classic volcanic complexes on Earth and provide a better basis for predicting future eruptions. A novel observational technique will be used. Because of the inaccessibility of the site remote sensing techniques (reflectance spectroscopy and multispectral mapping) will be applied along with some direct sampling and laboratory sample characterization. Existing astronomical laboratory instrumentation will be modified for terrestrial use. Laboratory characterization of accessible rock sample will be conducted both spectrally and by more conventional petrological methods to determine the most productive spectral regions for field measurement. A program of in-the-field spectroscopy and multispectral imaging will be designed and carried out with emphasis on calibrations and aspects of observing which are unique to terrestrial applications. As observational data are obtained and reduced they will be analyzed to determine the optimum ways to map compositional units in Kilauea and this mapping will then be initiated

W81-70422 677-41-11
Lyndon B Johnson Space Center Houston Tex
THEORETICAL STUDIES OF RADAR BACKSCATTER
A W England 713-483-2411

The objective of this RTOP is to develop theoretical models which accurately describe the volume scattering of incident microwave radiation within natural surface media such as forest canopies ice and snow and lunar and planetary regoliths. This RTOP will (1) extend existing capability to perform numerical backscattering calculations employing the Mie scattering approximation (2) develop new algorithms to perform such calculations employing Kirchoff's method (3) develop realistic geometric representations of natural materials for incorporation in theoretical models and (4) compare numerical (model) results with experimental (empirical) backscattering measurements

W81-70423 677-41-12
Lyndon B Johnson Space Center Houston Tex
ANALYSIS OF MULTIFREQUENCY/MULTIPOLARIZATION SAR IMAGERY
M B Duke 713-483-4464

The objective of this RTOP is to (1) determine information gained from analysis of multifrequency/multipolarization data compared with single frequency/polarization imagery and (2) determine information added by combining multifrequency/multipolarization SAR data with multispectral VIS-IR data. This will be accomplished by Synthetic Aperture Radar (SAR) (1) registering multifrequency/multipolarization A/C SAR data for a region around Flagstaff Arizona (2) applying image enhancement techniques (edge enhancement filtering channel rationing etc) to multichannel radar imagery (3) registering other remote sensing data to SAR imagery and applying image enhancement techniques

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

and (4) evaluating geological information gained by multichannel SAR data alone and in conjunction with VIS-IR data

W81-70424 **677-42-01**

Goddard Space Flight Center Greenbelt Md

GEOBOTANICAL TEST SITE INVESTIGATIONS

mark Labovitz 301-344-4928

The objectives of the geobotanical field project conducted at NASA/ Goddard Space Flight Center are (1) to determine the utility of different spectral bands for mapping the geobotanical anomaly over a known metal sulfide deposit (2) to determine the best spatial resolution for mapping the anomaly (3) to determine the best temporal window for mapping the anomaly (4) to assess the reproducability of spectral biogeochemical and geobotanical measurements within the anomalous area over several growing seasons and (5) to select other geobotanical anomalies more complex than the first on which to evaluate the general applicability of the above determinations In FY-81 to FY-83 the objective will be to 1) select a series of field sites of increasing topographic and botanical complexity commencing with the least complex site in Mineral, Virginia 2) collect relevant ground truth a several spatial scales on a square sampling grid at monthly intervals throughout the growing season 3) simultaneously collect remote sensing data in spectral bands suggested by previous research and 4) use data to perform analyses which have as their major factors complexity spatial scale and time

W81-70425 **677-43-01**

Lyndon B Johnson Space Center Houston Tex

TERRAIN MODELS FOR SAR DEVELOPMENT

M B Duke 713-483-4464

(677-41-04 677-41-11 677-41-12)

This investigation is developing the capability to evaluate optimal design parameters for synthetic aperture radar systems in geological applications Simulation models will allow the effects of selecting antenna depression angles frequency polarization look direction resolution and other factors of satellite SAR systems on the detection and characterization of geological features In turn the procedures will allow criteria to be developed for systematic characterization of landforms based on SAR data The approach is to (1) develop computer simulation models of natural terrain employing progressively more complicated geometrical descriptions of surface landforms (2) model the backscattering response (backscatter coefficient polarization etc) of individual elements in the geometrical representations and synthesize artificial SAR images for these representations (3) compare computer synthesized SAR images with aircraft radar imagery available over selected test sites to verify simulation models and (4) to test the effects of varying SAR system parameters on the simulated imagery and determine the optimum system configuration for landform identification

W81-70426 **677-43-03**

Lyndon B Johnson Space Center Houston, Tex

TECTONIC STRUCTURE IN PAKISTAN

W C Phinney 713-483-3816

The objectives are to (1) employ LANDSAT MSS and RBV imagery in identifying tectonic structural features of recent geological age within Pakistan including active faults broken fault segments basin subsidence uplift and active fold belts and (2) prepare a comprehensive map of recent tectonic structures within Pakistan The objectives will be accomplished by (1) compiling LANDSAT MSS mosaic of study area to serve as structural base (2) obtaining supporting enhanced imagery RBV imagery aerial photography geophysical survey data and ground based measurement and register these other data sets to the LANDSAT base map (3) identifying major structural features in LANDSAT imagery and examine the expression of such features in ancillary data sets (4) collaborating with Pakistan geologists to verify results of imagery analysis and (5) compiling detailed studies of regional districts into comprehensive tectonic map

677-43-05

Lyndon B Johnson Space Center Houston Tex

INTEGRATED STUDY OF CONTINENTAL RIFT SYSTEMS

D P Blanchard 713-483-2781

The objectives are (1) to construct models for the formation and evolution of the Rio Grande Rift (RGR) and for the development of resources associated with it (2) to constrain and enhance these models by use of space acquired data in conjunction with ground based and aircraft data (3) to apply models to technique development for resource evaluation (4) to develop techniques for using remote sensing data (R-S) to study structure composition and evolution of large crustal features and (5) to develop requirements for future remote sensing systems for spacecraft The approach is (1) to identify experts for RGR region and establish a working group (2) to identify the major scientific problems associated with the RGR (3) to propose topical research areas to bring together classical and R-S techniques on significant problems (4) to assemble data bases appropriate to the topical problems (5) to carry out coordinated research and multidiscipline modeling on topical problems and (6) to evaluate impact of R-S on modeling process

W81-70428

677-44-01

Jet Propulsion Laboratory Pasadena Calif

Pipeline/Nuclear Plant Engineering Geology

Harold Lang 213-354-3440

The objectives are to assess the utility of LANDSAT imagery (MSS and RBV) in evaluating environmental hazards and engineering factors involved in major energy related construction projects and to compare costs for site selection studies employing satellite imagery analysis with those for similar studies using conventional studies The approach is to (1) complete LANDSAT 3 data base for selected engineering projects (primarily the Northern Tier Pipeline Project extending from the state of Washington to Minnesota) (2) identify features of engineering interest (landslides fault traces subsidence cracks sand and gravel deposits etc) (3) compare location size and spatial density of engineering features identified on satellite imagery with ground truth data (4) evaluate accuracy and limitations of LANDSAT RBV and MSS imagery for engineering investigations and (5) determine net difference in time and costs required for engineering studies using currently available space-acquired data

W81-70429

677-45-01

Goddard Space Flight Center Greenbelt Md

CRUSTAL MODELING USING SATELLITE POTENTIAL FIELD DATA

P T Taylor 301-433-5600

The objective of the RTOP is to develop methods of applying satellite-derived magnetic and gravity data together with other geologic information to the study of structure and composition of selected geologically important large regions of the Earth's crust Magsat and POGO satellite magnetic anomaly maps will be constructed for geologically significant structures on a global scale These magnetic anomaly maps will be interpreted by means of vector and scalar anomaly representation by suitable mathematical models which reflect the known geology and structure of a region under study These models will provide some indication of the geological structures producing the anomalies One of the worldwide rift structures has been selected for detailed investigations the Rio Grande Rift system Other areas of either significant resource potential or geological interest have been chosen for detailed study the Texas Panhandle region and the largely unknown Arctic region The RTOP supports the following major programs (1) non-renewable resources (2) geodynamics and (3) technology transfer These in turn support the following end objectives (1) plate tectonics (2) regional geophysics and (3) resource assessments

W81-70430

677-45-03

Goddard Space Flight Center Greenbelt Md

PETROLOGIC AND GEOPHYSICAL STUDIES OF THE SOURCE OF LONG WAVELENGTH CRUSTAL MAGNETIC ANOMALIES

H H Thomas 301-344-5412

(677-45-01 677-45-04 667-45-06)

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

The objectives are (1) to further our ability to interpret Magsat and POGO magnetic anomaly data through development of our understanding of the magnetization and petrology of rocks which make up the earth's magnetic crust (2) to model, quantitatively the magnetic fields produced at aircraft and satellite altitudes by the determined abundance and spatial configuration of these subsurface rock bodies and (3) to develop schemes for the evolution of magnetic mineralogy which provide chemical and physical constraints on the formation of rocks and minerals of resource interests. The RTOP will determine magnetic and petrologic properties of xenolithic rocks characteristic of the earth's crust and upper mantle. Petrologic data will, along with rock measurement enable the construction of profiles of rocks and minerals within the magnetic layers and especially the variation of magnetization with depth. Rocks characteristic of various tectonic settings will be analyzed to ascertain relationship between tectonics, mineralization and magnetization. This RTOP supports the following major program element: Earth composition. This in turn supports the following end objective of mineral resources assessment.

W81-70431 **677-45-04**

Goddard Space Flight Center Greenbelt Md
MAGSAT CORRELATIVE STUDIES

R A Langel 301-344-6565
(677-45-01 677-45-03 677-45-05)

The objectives of the RTOP are to select Magsat data appropriate for crustal anomaly studies, suitably process that data and derive a global magnetic anomaly map. This RTOP will be accomplished by (1) selecting data from magnetically quiet periods (2) removing the core field as represented by a spherical harmonic expansion (3) removing the best available approximation of external field and (4) deriving 2 deg x 2 deg average residual fields and plot the results. This RTOP supports the Non-Renewable Resources Program which in turn supports the end objectives of resource assessment.

W81-70432 **677-47-01**

Jet Propulsion Laboratory Pasadena Calif
AIRCRAFT THERMAL INFRARED SCANNER
Alexander F H Goetz 213-354-3833
(677-41-02 677-41-03)

The purpose of this task is to design and construct a 6-channel aircraft multispectral scanner to span the wavelength region 8 to 13 micrometers. The scanner will cover the bands 8.3 to 8.8, 8.8 to 9.3, 9.3 to 9.8, 10.1 to 11.0, 11.0 to 12.0, 12.0 to 13.0 micrometers with an NE delta T of 0.5 K at 300 K target brightness temperature. Remote sensing to the present time has focused on identification and discrimination of rocks using visible and near infrared reflectance measurements. This region tends to be dominated by presence and oxidation state of iron and by water in hydrous silicates principally clays. The so-called emission region (8 to 14 micrometers principally) contains an abundance of spectral bands arising from fundamental Si-O vibrations with detailed band position depending upon Si-O polymerization in silicate minerals. The diagnostic information available has as yet been utilized sparingly primarily because of the lack of instrumentation. The Thermal Infrared Multispectral Scanner (TIMS) will be built using existing technology and based on the Daedalus DS-1260 and DS-1280 scanners. Items requiring new development are the scan head reference sources and 6-channel spectrometer. The design material is subject to NASA approval. Test areas will be chosen for which extensive ground based and SMIRR data exist.

W81-70433 **677-47-02**

Lyndon B Johnson Space Center Houston Tex
EXTENDED SCENE RADAR CALIBRATION
R G Fenner 713-483-3073

The purpose of this RTOP is to establish a method to verify the precision and accuracy of scatterometers and imaging radars used for remote sensing on JSC aircraft. The precision and accuracy of microwave remote sensors must be established and verified before there can be meaningful results in investigations such as soil moisture where quantitative traceable measurements of radar backscatter are required. The hardware, software and

measurement techniques for performing this RTOP were developed in FY-78. The FY-79 and FY-80 effort consisted of a comprehensive test series utilizing the 13.3 GHz, 4.75 GHz, 1.6 GHz and 400 MHz aircraft scatterometers. Correlating ground measurements were taken at 13.3 GHz, 4.75 GHz and 1.6 GHz. Airborne scatterometer data bases were gathered at Northrup Strip, White Sands Missile Range, Jornada Experimental Range, NM and Death Valley, CA. In addition during FY-79 data was gathered at Jornada Experimental Range for study of row effects on radar backscatter. The FY-81 activity will consist of further detailed studies of extended homogeneous roughness scenes. Analysis of FY-79 and FY-80 data have shown that the smoother areas of Northrup Strip and Death Valley have too much subsurface moisture to appear homogeneous to microwaves. Test plots with increasing values of random roughness will be measured with ground and airborne scatterometers. This data will be evaluated for precision and accuracy. Efforts will be made to eliminate subsurface moisture effects by site selection and/or time of measurement.

W81-70434 **677-47-03**

Jet Propulsion Laboratory Pasadena Calif
NASA AIRBORNE IMAGING RADAR FACILITY
E R Caro 213-354-3096

The work described in this RTOP provides for the continuing operation and maintenance of an existing airborne synthetic aperture radar (SAR) and the incorporation of specific modifications to the equipment in support of scientific investigations being performed under RTOP 677-41-04. Modifications planned for FY-81 are (1) simultaneous dual polarization operation and (2) digital data recording of radar data. The imaging radar facility is available to other NASA funded investigators as a research tool and provides a versatile, cost effective means of conducting experiments and acquiring data for demonstration of remote sensing concepts.

W81-70435 **677-48-01**

Jet Propulsion Laboratory Pasadena Calif
SEASAT DIGITAL SAR PROCESSING (NON-RENEWABLE RESOURCES)
C F Leang 213-354-3798
(677-37-06)

The objective of this RTOP is to process Seasat radar data to produce synthetic aperture radar images of selected areas in support of Earth resource application studies. The processing will be performed using the Interim Digital Processor at JPL. Each image will exhibit a 25 meter resolution and cover a 100 Km square target area. At least 66 images will be produced in FY-81.

W81-70436 **677-76-01**

Jet Propulsion Laboratory Pasadena Calif
SEASAT DIGITAL SAR PROCESSING (RENEWABLE RESOURCES)
C F Leang 213-354-3798
(677-48-01)

The objective of this RTOP is to process Seasat radar data to produce synthetic aperture radar images of selected areas in support of Earth resource application studies. The processing will be performed using the Interim Digital Processor at JPL. Each image will exhibit a 25 meter resolution and cover a 100 Km square target area. At least 50 images will be produced in FY-81.

W81-70437 **677-76-04**

National Space Technology Labs Bay Saint Louis Miss
VERY LOW-COST DATA SYSTEM 16-BIT MICROPROCESSOR-DRIVEN ELAS
Ferron Risinger 601-688-3586

The primary objective of this effort is to define, assemble and demonstrate a very low-cost data analysis system that is 16 bit microprocessor driven, equipped with operating subsystem ELAS and is capable of interactively processing Landsat MSS data, NCIC topographic data, soils data, rainfall data, and thematic mapper simulator data to produce resource management information. The system will be demonstrated and specifications will be made.

available so that anyone in industry can produce a duplicate system. A microprocessor driven low cost data analysis system will be designed around a 16 bit INTEL 8086 microprocessor. Currently existing operating subsystem ELAS e.g. multichannel multitemporal image analysis software for converting Landsat MSS and supporting auxiliary data to resource management information will be translated to run on the 16 bit INTEL 8086 microprocessor.

W81-70438 677-77-01

Goddard Space Flight Center Greenbelt Md

MULTISPECTRAL LINEAR ARRAYS FOR THE SHORT-WAVE INFRARED (MLA/SWIR)

Leslie L. Thompson 301-344-8107
(677-37-02 677-39-02)

The objective of this RTOP is to design, fabricate and demonstrate the required multispectral linear array technology (MLA) for resource observations in the short-wave infrared (SWIR) spectral region and to provide supporting research studies related to remote sensing in the visible near infrared the SWIR especially in the area of calibration. In order to develop the SWIR array major contracts will be awarded to private industry. Development to proof-of-concept (Phase 1) will be pursued by two contractors with one contractor selected to develop a prototype array of nominally 500 to 1000 elements in a Phase 2 effort. Supporting studies will be accomplished inhouse to assure correct performance specifications are applied to the SWIR array development and to develop appropriate calibration techniques and algorithms. This RTOP supports (1) Landsat (2) shuttle payloads and (3) the Operational Land Observing System. These in turn support the following objectives: agricultural and mineral resources, environment and disaster assessment.

OFFICE OF SPACE SCIENCE

Planetary Geology

W81-70439 151-01-60

Ames Research Center Moffett Field Calif

PLANETOLOGY AEOLIAN PROCESSES ON PLANETS

E F Danielsen 415-965-5527

The objective of this activity is to determine the parameters governing aeolian (wind) processes in various planetary environments by means of wind tunnel simulations, laboratory experiments, Earth analog studies and analyses of spacecraft data. The approach will be to conduct experiments using wind tunnel and other laboratory apparatus to study at various atmospheric pressures and compositions (1) conditions for the initiation and sustainment of particle movement (2) model studies of erosion and deposition around various landforms (3) rates of erosion of various natural materials and (4) study by scanning electron microscopy of surface textures produced by wind abrasion under planetary conditions. Field experiments will be conducted to determine threshold conditions under natural conditions and to determine aeolian patterns around full-scale landforms and the use of a field portable wind machine for studying the dynamics of dune migration. Long term field experiments will continue on the rate of aeolian erosion under natural conditions to provide a check for the laboratory experiments. Spacecraft data will be analyzed to interpret aeolian processes on Mars and Venus.

W81-70440 151-01-70

Jet Propulsion Laboratory Pasadena Calif

PLANETARY GEOLOGY

R S Saunders 213-354-3815

The proposal for Planetary Geology and Mars Data Analysis studies consist of fifteen tasks to be carried out in FY-81. These tasks are being performed in a variety of disciplines: volatile evolution, origin of Mars fluvial features, planetary photogeology, interpretation, geomorphology of valley networks on Earth and Mars, planetary surface tectonics, planetary image facility, planetary surface weathering study, planetary surfaces physical processes, Voyager data analysis of surface variations on Io, geomorphology of the Galilean Satellites, planetary radar

interpretation, radar determination of Venus spin vector, systematic near-Earth asteroid search, computerized video telescope detection of near-Earth asteroids, Siding Spring/Palomar faint asteroid survey and asteroid flyby mapping spectrometer study.

W81-70441

151-02-60

Ames Research Center Moffett Field Calif

THEORETICAL STUDIES OF PLANETARY BODIES

J B Pollack 415-965-5530

The purpose of this research is to obtain a better understanding of selected problems pertaining to planetary surface phenomena, the composition, structure and evolution of planetary bodies and their satellites and the origin of the solar system by means of theoretical investigations employing the results of spacecraft and ground-based experiments. Theoretical knowledge, physical insight and mathematical modeling techniques are used together with astronomical and geological data to construct self-consistent mathematical descriptions of planetary processes and structure. Analysis and interpretation of the results of these model calculations are applied to such topics as the evolution of Jupiter and wind blown surface features on Mars and climatic change on Mars.

Planetary Materials

W81-70442

152-01-40

Lyndon B Johnson Space Center Houston Tex

PLANETARY MATERIALS LUNAR SAMPLE ANALYSIS

J W Harris 713-483-3274

Lunar sample analysis is a multidisciplinary effort carried out by individual scientists and teams consisting of three program areas (with the estimated number of grants/contracts to be awarded): (1) mineralogy/petrology (14 grants/contracts), (2) geochemistry (19 grants/contracts) and (3) physical properties (7 grants/contracts). The Lunar Sample Analysis Program is a continuing effort aimed at understanding the origin and history of the Moon including its age, chemical and mineral composition and physical properties. Data obtained provides valuable information on the history of the Sun and baseline data for the planetary processes that will aid in the planning for future planetary missions.

W81-70443

152-02-40

Lyndon B Johnson Space Center Houston Tex

PLANETARY MATERIALS LABORATORY AND ANALYTICAL STUDIES

R J Williams 713-483-2781

(152-04-40 153-06-40)

The objective of this research is to produce a quantitative understanding of the chemical and physical properties of planetary materials and of the processes by which these materials have been formed and evolved. This quantitative understanding is obtained through analytical studies of lunar samples, meteorites, cosmic dust and closely related synthetic or terrestrial materials. A variety of analytical techniques—X-ray fluorescence, instrumental neutron activation, solid source and gas mass spectrometry, gas chromatography, ion and electron microprobe analysis, and scanning and transmission electron microscopy—are used as appropriate to quantitatively determine the physical, chemical and mineralogical properties of planetary materials. Experimentation under controlled shock conditions is used to study the effects of physical processes which may have operated during the formation of planetary materials.

W81-70444

152-04-40

Lyndon B Johnson Space Center Houston Tex

CURATION OF EXTRATERRESTRIAL SAMPLES

P Butler Jr 713-483-3274

The Lunar Sample Program is supported in this program by providing for maintenance of the sample collection under controlled environmental conditions, research on techniques of preparation and preservation of lunar, meteoritic and cosmic dust samples, documentation of the distribution and use of samples, preparation and publication of sample information catalogs containing petrographic inventory and processing data, and implementation of the sample control system. Operation is carried out by a staff of Civil Service scientists and administrators directing a

OFFICE OF SPACE SCIENCE

laboratory effort undertaken by contractor personnel. Most effort is involved in preparation of sample materials for approximately 55 domestic and 20 foreign Principal Investigators in the Lunar Sample Program.

W81-70445 **152-05-40**
Lyndon B Johnson Space Center Houston Tex
JSC GENERAL OPERATIONS SUPPORT - PLANETARY MATERIALS

M B Duke 713-483-4464

This plan provides for support by JSC of a general operational nature necessary to the planning and conduct of OSS Planetary Materials Programs. The plan provides JSC support services for the annual lunar and planetary science conference and the visiting scientist programs of NASA. Support services include transportation logistics, publications library, audio-visual, photographic data processing, fabrication and in-house laboratory utilization. A certain amount of in-house laboratory operations are dedicated through this plan to general program support such as that provided to pre-proposal definition studies, specialized studies for the Sample Curator and mission support activities. This plan also supports a continuing study by in-house scientists to define the role of the planetary program. This study systematically identifies gaps in current knowledge and defines specific scientific requirements for future space missions.

Planetary Geochemistry and Geophysics

W81-70446 **153-01-60**
Ames Research Center Moffett Field Calif
FORMATION, EVOLUTION, AND STABILITY OF PROTO-STELLAR DISKS

P M Cassen 415-965-5597

The objectives of this research are to obtain an understanding of the solar nebula and proto-stellar disks in general by analysis of theoretical models based on hydrodynamic and thermodynamic principles. The formation of proto-stellar accretion disks from collapsing gas clouds will be studied and the evolution of their densities and thermodynamic properties will be described. Other objectives are to examine by numerical experiments the stability of proto-stellar disks against gravitational condensation and to explore the role of instabilities in planetary formation. Results will be analyzed in the light of observations of the solar system and astronomical objects identified as proto-stars.

W81-70447 **153-02-40**
Lyndon B Johnson Space Center Houston Tex
EXPERIMENTAL STUDIES
W C Phinney 713-483-3816

The objective of this research is to develop the values of necessary parameters that allow a quantitative understanding of the chemical and physical processes that produce observed planetary materials. The development of the necessary data is accomplished by means of experimentation with both natural and synthetic materials under controlled conditions of temperature, pressure, oxidation-reduction, shock and composition. Specific mineralogic compositions, textural relations and phase assemblages can thus be related to specific sets of chemical and physical conditions that may occur on or within planetary bodies. These conditions provide constraints for interpretations of planetary processes.

W81-70448 **153-02-70**
Jet Propulsion Laboratory Pasadena Calif
PETROLOGY LAB
Anthony A Finnerty 213-354-4785

This RTOP supports investigations being conducted in planetary petrology through experiments on model compositions, terrestrial rocks, meteorites and lunar rocks and thermodynamic theory. The investigations will interface with ongoing studies in planetology to provide petrological constraints for models of composition, petrology and thermal structure of planetary interiors.

W81-70449

153-03-42

Lyndon B Johnson Space Center Houston Tex

INTERIOR MODELS

W C Phinney 713-483-3816

The objective of this study is to provide further models of planetary scale chemical differentiation, outgassing of atmospheres and petrogenesis. The study will utilize the temperature and mass transport outputs from global thermal models to determine the effects on partial melting and migration of melts.

W81-70450

153-05-70

Jet Propulsion Laboratory Pasadena Calif

PLANETARY DYNAMICS

William R Ward 213-354-2594

This program of dynamical investigations is directed at increasing our understanding of solar system formation and evolution. Gas-planet gravitational interactions including both secular resonance effects and nebula tides will be studied. These studies may furnish much needed boundary conditions for solar system formation models. Planetary accretion models will be developed particularly for the outer planets. Studies of planetary ring dynamics will continue with possible applications to Saturn's rings. Secular resonances as a means of transporting asteroidal material to Earth and Mars crossing orbits will continue to be investigated. The effects of Jupiter resonances on the asteroid belt and the Trojans will be examined in more detail. Observations to establish rotation rates and accurate orbits of asteroids will be carried out. Advanced modeling of the Oort cometary cloud will also be pursued. Further studies of the role of tides on Jupiter and Io in maintaining the three-body lock and heating Io will be made. The effects of dissipation on lunar physical librations, the generation of planetary wobble resonances and the tidal histories of asteroidal satellites and the Pluto/Satellite system are other theoretical issues that will be examined. In addition new observations of Saturn's new satellites are needed to obtain more accurate orbits.

W81-70451

153-06-70

Jet Propulsion Laboratory Pasadena Calif

PLANETARY SYNTHESIS

Gary A Ransford 213-354-2451

This RTOP consists of eight tasks in the areas of comparative planetology of satellites, geochemical mapping, surface properties of planetary satellites, lunar multispectral imaging, Jovian satellite geophysics, equipment development for remote sensing experiments and spectrogoniometry.

W81-70452

153-07-40

Lyndon B Johnson Space Center Houston Tex

REMOTE SENSING

W C Phinney 713-483-3816

The objective of this research is to optimize the ability to interpret and utilize remotely sensed data from planetary surfaces. A laboratory program based on infrared interferometry of particulate materials will define the spectral radiative transfer regime in planetary surfaces. The results when used with remotely sensed observations will yield data which can be interpreted in terms of the experimental work and which can be compared to results from other techniques. A second program will utilize mathematical techniques to improve the spatial resolution of X-ray fluorescence and gamma ray data used for lunar geochemical maps.

W81-70453

153-07-70

Jet Propulsion Laboratory Pasadena Calif

RADAR STUDIES

Charles Elachi 213-354-5673

The objectives of this RTOP are to (1) develop a data base for the interpretation of radar data of planetary surfaces which will be obtained with an orbiting sensor. Specific mission in mind is the VOIR 84. (2) develop the techniques to interpret these data. (3) get the planetary sciences community familiar with the interpretation of radar images and (4) develop an Imaging Radar Data Center at JPL in support of the above activities. The data base will consist of (1) A/C Seasat-A and SIR-A radar images, (2) LANDSAT images, (3) geologic maps.

and (4) ground images These data will be obtained for a wide variety of representative test sites

W81-70454 153-08-50

Goddard Space Flight Center Greenbelt Md

EXPERIMENTAL MAGNETISM

Peter Wasilewski 301-344-8317

An experimental magnetism program is conducted to develop a basis for the understanding of shock induced magnetization in FeNi alloys to calibrate the FeNi system to refine model system calibrations, and to develop metallographic magnetic criteria in order to provide a fundamental basis for analysis of the magnetic record in extraterrestrial materials This information is to be used in evaluating both laboratory developed magnetic records in natural and synthetic samples and the magnetic record in specific natural samples as a test of the effectiveness of the program Utilizing the light gaS gun at the Goddard Space Flight Center specimens of Copper-Iron alloy which contain fcc iron spheres will be impacted to transform the nonmagnetic fcc iron to magnetic bcc iron These specimens will be used to characterize the magnetic effects associated with a first order fcc to bcc magnetic transformation The discs will be remachined and reimpacted to characterize the magnetic effects due to impacting a fine particle bcc iron In addition thermal demagnetization of both NRM states will be evaluated and the effects of recrystallization investigated Iron Nickel alloys will be subjected to varying shock levels after being prepared via different thermal histories

W81-70455 153-08-60

Ames Research Center Moffett Field Calif

NASA AMES RESEARCH CENTER VERTICAL GUN FACILITY

O L Koontz 415-965-5526

The Ames Research Center Vertical Gun Range is a ballistic facility used to simulate and study the physics and mechanics of planetary impact cratering phenomenon Ballistic technologies utilizing light gas gun powder enable acceleration of projectiles up to 2 centimeters diameter at relative velocities of approximately 8 km/sec By varying the gun's angle of elevation with respect to the target vacuum tank impact angles from 0 deg to 90 deg with respect to the gravitational vector are possible In conjunction with the Lunar and Planetary Institute Ames Research Center will operate the Ames Vertical Gun Facility as a national facility manage its operations including manpower expendables and targets maintain equipment and provide for facility modification and upgrading as needed Ames Research Center proposes to operate the facility in such a manner as to provide maximum support to the scientific community in the studying and understanding of impact processes in planetary formation and modification

W81-70456 153-10-40

Lyndon B Johnson Space Center Houston Tex

JSC GENERAL OPERATIONS - GEOPHYSICS AND GEOCHEMISTRY

M B Duke 713-483-4464

General operations support a variety of institutional and scientific support tasks at JSC that are considered essential for the conduct of research and for implementation of the Planetary Geophysics and Geochemistry Program Center support services such as printing computer photographic and graphics are provided through a procedural agreement with the Lunar and Planetary Institute In-house support provides for co-sponsorship of conferences laboratory costs required by visiting scientists using existing facilities, and for costs required to operate common laboratory facilities and to provide for support services from other Center elements

Planetary Atmospheres

W81-70457

154-10-80

Ames Research Center Moffett Field Calif

PLANETARY ATMOSPHERIC COMPOSITION AND STRUCTURE

J B Pollack 415-965-5530

Theoretical modeling and spacecraft data interpretation are used to determine the properties and physical processes characteristic of planetary atmospheres These properties include their temperature structure aerosols cloud layers gaseous constituents and opacity sources Emphasis is placed on reducing and analyzing data returned from spacecraft missions such as Pioneer Venus or preparing for data expected from future spacecraft missions such as Voyager However use is also made of relevant ground-based observations Tasks relevant to Pioneer Venus include data analysis of results from the large probe infrared radiometer atmospheric structure and gas chromatography experiments Other tasks are directed at investigating the properties of Titan's atmosphere and the rings of Saturn Such investigations are relevant for both the upcoming Voyager mission through the Saturn system and the contemplated SOP2 mission

W81-70458

154-10-80

Jet Propulsion Laboratory Pasadena Calif

PLANETARY ATMOSPHERES COMPOSITION AND STRUCTURE

J T Bergstrahl 213-354-2517

The Pioneer Data Analysis subtask covers an analysis of Jovian photopolarimetric (IPP) and radiometric (IRR) data from Pioneer 10 and 11 spacecraft The approach is to use the spacecraft data in conjunction with selected ground-based observations made near the times of the spacecraft encounters to constrain realistic models of Jupiter's lower stratosphere and upper troposphere This includes temperature and cloud profiles for major regions of the planet for which adequate geometric control has been established The work is divided into three distinct parts (1) qualitative comparison of Jovian images at visible and thermal infrared wavelengths (2) quantitative analysis of Jovian thermal infrared data to derive temperature structure and some cloud properties and (3) quantitative analysis of Jovian reflectivity data to derive cloud distribution and microphysical properties The Outer-Planet Equilibrium Models subtask continues the development of detailed model atmosphere algorithms applicable to the tropospheres and stratospheres of the outer planets A computer code which predicts infrared flux divergence pressure-temperature profiles and the corresponding thermal emission spectra is now operating At present our approach is based on standard assumptions of radiative convective and local-thermodynamic-equilibrium states The calculational procedure involves a combination of analytic approximations and straightforward numerical techniques in the context of a radiative flux divergence formulation All aspects of the calculations including the method must be examined and evaluated Survey models have been generated for atmospheres composed of H2 He CH4 C2H6 and C2H2 and incorporating a relatively crude treatment of aerosol heating Nonuniform aerosol distributions exhibit striking effects particularly in the stratospheres effects which point dramatically to the need for improvements and refinements in the treatment of aerosol heating (as part of this ongoing task)

W81-70459

154-20-80

Goddard Space Flight Center Greenbelt Md

PLANETARY ATMOSPHERIC DYNAMICS

J A Pirraglia 301-344-6783

Planetary missions supplemented by ground based and airborne instruments have greatly increased our knowledge of the atmospheres of Venus Mars Jupiter Saturn and their satellites The planets and their satellites present contrasts in mass rotation rates radiative time constants heat deposition and topographic influence of the atmosphere and for a better understanding of these disparate atmospheres it is necessary to develop a general approach to theoretical atmospheric dynamics

OFFICE OF SPACE SCIENCE

based upon the existing data obtained from the planetary missions. The widely differing conditions permit the isolation of specific phenomena and allow comparisons of different regions of the parameter space associated with a particular phenomenon. Atmospheric circulation is strongly affected by energy and momentum transport. The relationship between the mean flow and the waves that contribute to the transport processes will be investigated through a study of forced waves and wave instabilities in an inhomogeneous mean flow and by a study of the influence of the higher order interaction terms on the mean flow. The transport or interaction models will be applied to the various planets which have different ranges of parameters to assess the models under a wide set of conditions.

W81-70460 154-20-80

Ames Research Center Moffett Field Calif

DYNAMICS OF PLANETARY ATMOSPHERES

R E Young 415-965-5515

The dynamics of the atmosphere of Venus is being studied using a 3-dimensional circulation model. The fully coupled nonlinear momentum and energy equations are solved numerically using a combination of finite differences and spectral methods. The principal goals are to understand the dynamical effects of varying planetary rotation rate, solar energy deposition, infrared opacity, atmospheric mass and composition.

W81-70461 154-20-80

Jet Propulsion Laboratory Pasadena Calif

DYNAMIC RADIATIVE INTERACTION

R W Zurek 213-354-3725

Dynamic-radiative interaction will be studied to understand the spectacular planetary-scale evolution of Martian great dust storms by simulating the basic interaction between dynamic and radiatively active airborne dust which occurs in a dusty atmosphere. Atmospheric dynamical models will be developed to understand major dynamical processes of the Venus atmospheric circulations. These include the solar related (tidal) component, large-scale instability mechanisms, and the thermospheric circulation. The thermospheres of Mars and Io will also be modeled to determine their basic dynamical characteristics. The radio scattering effects observed during the radio occultation measurements of various planetary missions will be analyzed to develop algorithms needed to study (1) turbulence in planetary atmospheres, (2) electron density irregularities in planetary ionospheres, and (3) the magnetic field in planetary and satellite ionospheres. Time-lapse Jupiter data products will be analyzed to complete assembly of a representative subset of the Voyager Jupiter photographs into time-lapse motion pictures which will clearly and accurately portray the visible activity of features in the Jovian atmosphere over two periods of several weeks each. These 16mm motion pictures showing constant regions of the planet on successive rotations and digital records of the map projected data sets will be delivered to the National Space Science Data Center (NSSDC) in forms which can readily and economically be accessed by any investigator engaged in meteorological research.

W81-70462 154-30-80

Ames Research Center Moffett Field Calif

PLANETARY CLOUDS, PARTICULATES, AND ICES

CLOUDS OF VENUS

R C Whitten 415-965-5498

(154-75-80 147-30-02 154-10-80)

A model of the Venus clouds which simulates gas phase sulfur chemistry and the height and size distribution of the cloud particles has been constructed. The model will be used to search for important but still unrecognized processes associated with the clouds and for possible errors in interpretation of cloud observations. A series of models are being used to evaluate the interactions between dynamics, radiation, electric fields and clouds. The cloud model will be used to look for processes which might cause precipitation and electric charging. A radiative model is used to clarify the relative importance of cloud and gas opacity to the unstable region at the cloud base and a simple dynamic model is used to assess the magnitude of cloud-radiation-dynamics interactions. Observational data on the

Venus cloud layer obtained by Pioneer Venus probe instruments have led to detailed knowledge of cloud structure. The data will continue to be analyzed and interpreted in terms of particle size distribution, height distribution and composition.

W81-70463

154-30-80

Jet Propulsion Laboratory Pasadena Calif

CLOUDS, PARTICULATES AND ICES

M S Hanner 213-354-4100

This RTOP covers 3 activities: (1) Venus cloud properties, (2) infrared emission of cometary dust, and (3) Jovian cloud properties. The objective of the Venus cloud study is to understand the condensation properties of the clouds, their liquid content, growth of cloud droplets, possibility of precipitation, and Venusian lightning. Mariner 10 and Pioneer Venus radio occultation data and probe data are used to derive the liquid content of the clouds. Effects of lightning on the chemical properties of sulfuric acid-water clouds will be studied experimentally. The objective of the cometary dust study is to compute the thermal emission of cometary dust grains as a function of particle size, wavelength and heliocentric distance, based on measured refractive indices for ice, silicates and absorbing materials. These models are compared with observations of infrared cometary emission, in order to derive the composition and dominant size range of the dust being emitted from specific comets, and are applied to predicting dust emission characteristics for potential target comets of a cometary mission. The objective of the Jupiter cloud study is to use Voyager Imaging and IRIS data combined with high resolution ground-based 5 micrometer images to determine physical parameters for the Jovian and eventually Saturnian clouds as follows: (1) categorize Jovian cloud images in terms of gross morphology and possible terrestrial analogs; (2) use Voyager data to map cloud stratigraphy; (3) use imaging and 5 micrometer data to determine the vertical wind shear in the Equatorial Zone (EZ); (4) combine Voyager imaging, IRIS, and 5 micrometer mapping to constrain chromophore models for the coloring agents of the Jovian clouds; (5) use IRIS imaging and 5 micrometer data to measure the upper atmosphere temperature structure in relation to the lower cloud opacities; and (6) combine dynamical data with morphology and stratigraphy to characterize fully regimes of activity in the Jovian atmosphere.

W81-70464

154-40-80

Jet Propulsion Laboratory Pasadena Calif

RADIATIVE TRANSFER IN CLOUDY ATMOSPHERE

M Chahine 213-354-2433

The objective of this research is the development and application of numerical techniques for the interpretation of remote sensing data obtained under realistic cloudy and hazy conditions. Specifically, studies will be conducted to (1) develop an analytical approach for uncoupling the thermal emission of the clear and cloudy portions of the field of view of an observing system, including the case of haze layer overlying the clouds; (2) develop and apply numerical method for the determination of the radiative transfer properties of clouds for Venus, Jupiter and Saturn and of rings for Jupiter and Saturn; (3) formulate an approach for the determination of gaseous mixing ratios, gases to cloud particles mixing ratios and composition profiles from measurements obtained in the presence of clouds; (4) apply these results to the study of information content of multiple scattering from model Jupiter and Saturn cloud and ring particles; and (5) apply these results to the analysis of the Jovian thermal sounding problem. By treating the cloud and haze effects on the clear-column radiance as short term oscillations, it is possible to uncouple the radiative effects of clouds and hazes from the radiative effects of gaseous absorbers. Once the clear-column temperature profiles are determined, the same radiance data could then be used to determine the heights, amounts, and radiative transfer properties of clouds and hazes.

W81-70465

154-50-80

Goddard Space Flight Center Greenbelt Md

ATOMIC AND MOLECULAR PROPERTIES OF PLANETARY

ATMOSPHERIC CONSTITUENTS

P E Jennings 301-344-7538

(196-41-54 198-10-01 188-41-55)

The principal goal of this molecular spectroscopy program is to develop an organized solid body of knowledge of the molecular properties of planetary atmospheric constituents. The objectives leading to the overall goal of this program as well as the approaches to be taken center around the need for ultrahigh resolution laboratory spectroscopy. Accurate interpretation of infrared molecular spectra of planetary atmospheres requires prior analysis of laboratory data of the highest possible spectral resolution. Single features apparent in medium or high resolution Fourier transform spectra are often composed of more than one molecular transition and the parameters (1) frequency (2) strength (3) lower state energy and (4) foreign-broadening must be known for each as input in derivations of thermal and chemical properties of the atmosphere. For infrared heterodyne observations the need for ultra-high resolution laboratory data is especially critical since the bandwidths accessible to these receivers are narrow and Doppler line profiles are completely resolved in the observed spectra. Conventional grating or FTS laboratory spectra are not capable of the required Doppler-limited resolution except in the near infrared.

W81-70466 154-50-80

Jet Propulsion Laboratory Pasadena Calif
ATOMIC AND MOLECULAR PROPERTIES
M Geller 213-354-2593

A broad program of theoretical and experimental studies pertaining to planetary atmospheres will be conducted with the following primary objectives (1) to understand the properties and determine the parameters of the constituents of planetary atmospheres (2) to apply experimental data (laboratory, astronomical and spacecraft) to the understanding and interpretation of spectral features of complex planetary atmospheres and (3) to apply these findings toward the design of ground based and spacecraft experimental concepts. The studies to be conducted in FY 81 pertain to the determination of millimeter and submillimeter spectra, theoretical spectroscopic development and continuation of collaborative effort with Dr. G. Birnbaum of the National Bureau of Standards on long path multithermal measurements of the opacity of major constituents of planetary atmospheres in the far infrared.

W81-70467 154-60-80

Goddard Space Flight Center Greenbelt Md
PLANETARY AERONOMY THEORY AND ANALYSIS
R E Hartle 301-344-8234

The basic objective is to study the observed properties of the neutral atmospheres and ionospheres of the planets and their satellites, including earth in order to identify and interpret the physical and chemical processes governing their behavior encompassing solar planetary relationships. The motivating philosophy here is that the study of processes occurring in the atmospheres and ionospheres of the planets and their satellites provides important insights into the nature of similar processes operative in the earth's atmosphere and ionosphere under different parametric conditions and vice versa. These investigations are pursued by analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated. The data is used to determine the various chemical, compositional, dynamical and energetic states of the respective atmospheres and ionospheres, including the transport and deposition of mass, momentum and energy in these regimes. In general, the approach involves the development of empirical descriptions of either global or small scale phenomena using data sets from a variety of spacecraft. These empirical descriptions of the atmospheres and ionospheres are subsequently interpreted using theoretical models developed to deduce the physical and chemical processes involved. Some of the specific phenomena addressed in this investigation include atmospheric and ionospheric motions in Venus and earth, interaction of solar wind and/or magnetosphere with atmosphere of Venus and earth, including modification of transport coefficients by plasma instabilities, solar planetary relationships, comparative planetary atmospheres, etc.

W81-70468

154-60-80

Jet Propulsion Laboratory Pasadena Calif
AERONOMY THEORY AND ANALYSIS
Wesley T Huntress 213-354-2140
(154-75-80)

In this fiscal year, there is one small task in this RTOP at JPL to continue the work done last year in developing a comprehensive 1D model of the chemistry in cometary comae. The objective is to identify the major photochemical and ionic processes occurring in cometary comae by comparing observations of the column densities of key constituents observed in comet spectra with column densities predicted by models with differing initial parent composition. The work is closely allied to laboratory work being conducted on ion molecule reactions in comets.

W81-70469

154-70-80

Goddard Space Flight Center Greenbelt Md
ULTRAVIOLET SPECTROSCOPY OF PLANETARY ATOMS AND MOLECULES
L J Stief 301-344-7529

The objectives of this research are to measure the optical properties of atoms, free radicals and molecules which are important in understanding the composition of planetary atmospheres and comets. Emphasis is placed on those problems which are of immediate concern for interpreting the results of rocket, satellite and planetary probe observations. Several types of spectroscopic measurements are made. First photoabsorption and photoionization cross sections are measured. Cross sections are also determined for producing ion or atomic fragments in given excited electronic states. Branching ratios are measured for excited states which radiate into lower level excited states via photon emission. Electron impact excitation cross sections are determined.

W81-70470

154-70-80

Jet Propulsion Laboratory Pasadena Calif
AERONOMY ENERGY DEPOSITION
Sandor Trajmar 213-354-2145

Electron impact excitation and ionization of species which are important in planetary environments (with major emphasis on the Jupiter environment) will be studied. Cross sections for these processes will be measured. The species will include both neutral atoms (Ne, Na, K, S, Mg, Ca, O, N, Si, Fe) and molecules (CO, H₂O, CO₂, CH₄, NH₃, SO₂). The measurements will be carried out utilizing spectrometers and techniques developed in our laboratories. The results will be made available to researchers involved in planetary observations and modeling. Efforts will be made to correlate the laboratory work with modeling needs as they develop and to help the interpretation of optical observations as well as the planning of future observations. Electron impact cross sections for elastic and inelastic scattering from positive ions will be measured. The ions will include Si⁺, S⁺, O⁺, O^{II}, H₂⁽⁺⁾, N₂⁽⁺⁾ and CO⁽⁺⁾ and are important components of the Io-Jupiter Torus System (sulfur and oxygen ions) and of cometary ionospheres (N₂⁽⁺⁾ and CO⁽⁺⁾). This laboratory work is correlated with the present and future cross section needs of modelers concerned with electron energy degradation and line radiation in these dilute plasmas. An experimental apparatus has been fabricated which can measure the optical emission cross sections produced by electron impact for atoms and molecules of planetary interest, especially those found in the Jovian planetary system. The proposed laboratory measurements have immediate application to the modeling of Voyager and International Ultraviolet Explorer UV observations of the Jovian planetary system emissions. In addition, the extensive observations of the Jovian system to be carried out by earth satellites (Copernicus, International Ultraviolet Explorer and Large Space Telescope) and by interplanetary spacecraft (Galileo and Solar Polar), need supportive laboratory data on strong emissions for mission planning and data analysis purposes.

W81-70471

154-75-80

Goddard Space Flight Center Greenbelt Md
COSMIC CHEMISTRY AERONOMY, COMETS, GRAINS
B Donn 301-344-5014

OFFICE OF SPACE SCIENCE

This RTOP studies physiochemical phenomena in planetary atmospheres comets and related aspects of interstellar matter. Laser spectroscopy photochemistry reaction kinetics and condensation processes are investigated and properties of atoms radicals molecules and grains are measured. These experimental results are used to interpret astronomical observations and develop theoretical models. Flash photolysis-resonance fluorescence apparatus with computer interface for real time data analysis yields absolute atom-molecule rate constants. A CW tunable dye laser may be used for radical detection. A tunable laser is used to detect and study properties of photofragments from planetary or cometary radicals. Gas phase condensation is used to simulate primordial solar system cometary or interstellar grains and to study mechanism of production. A particle accelerator irradiates ice mixtures to study cosmic ray effects on comets. The vaporization process of simulated cometary ice mixtures is investigated with various gas composition analyzers. The spectra of comets to mag 15 and beyond are systematically obtained at Mt. Lemmon Observatory University of Arizona. The IUE observatory is used to obtain ultraviolet spectra of comets brighter than about mag 7.

W81-70472 **154-75-80**

Ames Research Center Moffett Field Calif

AERONOMY OF PLANETARY ATMOSPHERES CHEMISTRY

R C Whitten 415-965-5498

(154-30-80 198-30-02 154-10-80)

Theoretical modeling is used to determine the chemical properties of the atmospheres of Titan and Mars. Estimates of the formation rates and abundances of hydrocarbon-amino acids due to charged particle reactions caused by cosmic rays or trapped particles will be made from model studies. Model studies of the Martian atmosphere are used to explain the temporal variation of zone and to relate the variations to changes in temperature and atmospheric water vapor. Laboratory studies of chemical processes important to the structure of planetary atmospheres are in progress. Measurements of the photolysis quantum yield of OCS have been completed and the possibility of photo-oxidation of SO₂ in an atmosphere of CO₂ is being investigated.

W81-70473 **154-75-80**

Jet Propulsion Laboratory Pasadena Calif

AERONOMY CHEMISTRY

Wesley T Huntress 213-354-2140

The objective of this work is to conduct laboratory investigations of the ion chemistry in planetary atmospheres and cometary comae. The goal of the ion chemistry work is to obtain product distributions and rate constants for ion-molecule reactions important in the atmospheres of Venus to the outer planets and in cometary comae. The major emphasis in this fiscal year will be on comets. A photochemistry study will elucidate the chemistry of the Venus atmosphere in the 60 to 90 km region. The roles of SO₂ and HCl in the Venus atmosphere will be studied with the particular objectives of explaining the photochemical stability of CO₂ and the detailed sulfur chemistry leading to cloud formation. Support will be provided to NASA Headquarters in the area of laboratory studies and a detailee to NASA Headquarters will support a survey of the planetary atmospheres program work in instrument development.

W81-70474 **154-80-80**

Goddard Space Flight Center Greenbelt Md

EXTENDED ATMOSPHERES

H A Taylor 301-344-6610

The objective of the RTOP is to advance the understanding of solar-planetary relationships using the evidence of the global characteristics of ionosphereneutral atmosphere variations as indicators of coupling processes regulating the upper atmosphere in the region extending from the exobase to the ionopause. By examining the behavior of the ionic constituents at lower altitudes near the exobase and at higher altitudes approaching the ionopause, insight is obtained with respect to collision dominated as well as collisionless processes. Such studies relate to longer term effects such as the basic planetary atmosphere evolution as well as short term effects such as the ionospheric response

to solar wind variability. The approach involves the examination and description of global data sets of satellite and ground-based data relevant to the composition structure and energetic states of the planetary atmosphere/ionosphere system. These descriptions include large scale results in the form of empirical models as well as phenomenological data sets descriptive of uniquely varying conditions or events. Results of the empirical studies are assessed in terms of current theoretical models. Comparison of model results for contrasting planetary conditions e.g. Earth and Venus provides a basis for testing basic physical concepts.

W81-70475

154-80-80

Jet Propulsion Laboratory Pasadena Calif

EXTENDED ATMOSPHERES

R S Wolff 213-354-5073

This RTOP is for modelling of the extended atmospheres of Europa Ganymede and Callisto and their interactions with the Jovian magnetosphere. The overall objective of the proposed research is to construct a variety of possible models of the magnetospheres of Europa Ganymede and Callisto and to study the interaction of each of these systems with a Jovian magnetosphere. From these models we should then be able to construct a set of observable criteria which would serve as unique signatures for each of the various models. Specifically we will continue construction begun in FY-80 of numerical and analytic models of magnetohydrodynamic (MHD) flow past each of the three satellites as a function of surface conductivity and the intrinsic magnetic fields of the satellites. Models will also be developed of each of the satellite atmospheres based on existing Voyager and ground based observations. To model the MHD flow past the satellites we have constructed a two dimensional Eulerian hydrodynamic code based on the Flux-Corrected-Transport (FCT) algorithm of J Boris and D Book of NRL. This code is able to handle both subsonic and supersonic flows. During FY-81 magnetic fields will be incorporated into the code and experimentation on magnetized flow past conducting spheres will be initiated. We shall also calculate the effect that any extant atmospheres of the satellites would have on the flow. In particular efforts begun in FY-80 to determine whether or not the atmospheres of the satellites present any obstacle to the flow will continue in FY-81. Cometary-like models of satellite atmospheres and ionospheres will be constructed assuming icy surfaces for all three satellites. Although water ice is most likely the dominant volatile other ices will also be considered. If a satellite's atmosphere is unable to stand off the Jovian plasma then unless a sufficiently strong intrinsic magnetic field exists the (corotating) plasma must impact the satellite surface directly.

W81-70476

154-90-80

Jet Propulsion Laboratory Pasadena Calif

ATMOSPHERIC EXPERIMENT DEVELOPMENT

Daniel J McCleese 213-354-2317

The objective of this task is to evolve new or improved infrared instrumentation and analysis techniques for NASA's program of planetary exploration from spacecraft. The emphasis is on the following goals: (1) profile temperature in outer planet atmospheres (2) identify and map major and minor atmospheric constituents and their variability (3) determine the circulation in regions of planetary atmospheres free of clouds (4) develop and utilize instrumentation to address these goals. At JPL we have an experienced infrared experiment group with expertise in detailed atmospheric modelling development of data analysis techniques and laboratory development of critical hardware. In a synergistic program of modelling and hardware development experiments are evolved for specific measurement goals. In this way improved experiments for the investigation of planetary atmospheres by infrared remote sensing will be available for future missions and earth orbital platforms.

W81-70477

154-90-80

Goddard Space Flight Center Greenbelt Md

PLANETARY ATMOSPHERE EXPERIMENT DEVELOPMENT

H B Niemann 301-344-8706

The objective of this work is to develop instrumentation and necessary specialized test and calibration techniques for in-situ neutral gas and ion composition and density measurements in

planetary atmospheres. The instrument development is focussed on neutral gas and ion mass spectrometry. Different atmospheric environments encountered in various planetary missions as well as the different scientific goals set for the studies of the planets require instrument performances which are highly mission specific. Work will be done in five areas. The first is mass spectrometer sensor development. Ion source efficiencies will be optimized for operation in high particle velocity regimes (or = 50 km/sec). High pressure ion source and large dynamic range analyzer systems will be developed for trace gas detection. The second area is sample inlet systems. Compact gas leaks for pressure reduction from high pressure atmospheres to ion source operating levels and sample enrichment techniques for trace gas analysis will be developed. The third area is calibration and test equipment. Intermediate velocity molecular and atomic beam systems and trace gas mixing systems will be developed to simulate expected planetary and cometary atmosphere conditions for evaluation of instrument performance and calibration. The fourth area is electronics systems. Advanced digital logic and analog control circuits for onboard data processing using micro processor and hybrid electronics packaging techniques will be developed. The fifth area is auxiliary systems. Light weight vacuum pumps for application in high pressure atmosphere on planetary entry probes will be developed.

Mars Data Analysis

W81-70478 155-04-80

Goddard Space Flight Center Greenbelt, Md
MARS DATA ANALYSIS

B J Conrath 301-344-6088

The Mariner 9 and Viking missions have provided extensive data sets which are available for the study of the Martian atmosphere. Investigations of selected physical processes which may provide new insight into phenomena occurring in the lower terrestrial atmosphere are of particular interest. This investigation studies the following dynamical phenomena in the Martian atmosphere: waves in the stratosphere; dust storms; the influence of the Martian atmosphere; waves in the stratosphere; dust storms; the influence of the planetary boundary layer on global tides; and local thermally driven circulations associated with topography. These phenomena are investigated through a combination of data analysis and theoretical modelling.

W81-70479 155-04-80

Ames Research Center Moffett Field Calif
PLANETARY ATMOSPHERES DATA ANALYSIS

J B Pollack 415-965-5530
(154-10-80 154-20-80 154-30-80)

The basic objective is to relate spacecraft and ground-based observation of planetary atmospheres models. Mariner 9 and Viking data yielded information on the structure, meteorology and aerosol content of the Martian atmosphere. A Martian atmospheric general circulation model will be utilized to aid in interpretation of data taken during the extended Viking mission and to assess the dynamical effects of suspended dust particles. A similar 2-dimensional model will be used for long term studies. Viking lander imagery data will be used in conjunction with IRIS and Viking X-ray data to determine distribution, particle size, optical depth and temporal variation of aerosols.

W81-70480 155-20-40

Lyndon B Johnson Space Center Houston Tex
MARS DATA ANALYSIS PROGRAM

W C Phinney 713-483-3816

The objective of these studies is to provide data on the physical and chemical processes which could have produced rocks and soil on Mars. These data should provide a basis for interpretation of the existing remote chemical, physical and geological data from Mars, particularly those provided by the Viking Mission. The studies will use a variety of theoretical, experimental, analytical and analog to obtain these data. The approach will be to use the technique of experimental and

theoretical petrology to provide data on melting relations and petrogenesis to use geochemical modelling techniques to constrain the evolution of rock and soil systems to use experimental simulations to quantify the effects of weathering on the properties of rocks, soils and minerals and to use terrestrial analogs of Martian surface structures to help constrain evolutionary models of Mars crust. A wide range of analytical techniques will be used to characterize the physical and chemical properties of materials.

W81-70481 155-20-70

Jet Propulsion Laboratory Pasadena Calif

MARS DATA ANALYSIS STUDIES

Bruce G Bills 213-354-4159

This RTOP includes JPL Mars data analysis tasks in the geophysics and geochemistry program. Tasks are being performed in a variety of disciplines including studies of topography, gravity and internal structure; atmospheric adsorption into the regolith and photometric and thermophysical properties of the surface of Mars as well as geodetic and dynamical studies of the satellites.

W81-70482 155-41-80

Jet Propulsion Laboratory Pasadena Calif

MARS DATA ANALYSIS - ASTRONOMY

Robert A Preston 213-354-6895

Radio tracking of the Viking Mars mission orbiters and landers have provided a wealth of radio science data. Much of this data remains to be analyzed. Viking Lander radio data continues to be transmitted and provides an opportunity for additional scientific return. This RTOP will (1) continue the acquisition of Lander Doppler and range data in support of radio science investigation both here at JPL and elsewhere; (2) utilize Lander data to improve the orbits of Mars and the Earth; determine Mars spin and precession (including seasonal effects); estimate the masses of several asteroids and limit a possible time variation in G; (3) process Lander radio observations concurrent with observations of background extragalactic radio sources (Differential Very Long Baseline Interferometry (Delta VLBI)) to provide precise angular measurements of Mars's position with respect to a nearly inertial dynamical reference frame for use in solar system dynamical studies; and (4) analyze orbiter radio signals to study the solar corona and solar wind.

W81-70483 155-50-01

Lyndon B Johnson Space Center Houston Tex

MARS DATA ANALYSIS PROGRAM GEOLOGY

W C Phinney 713-483-3816

The broad objective of the study of planetary surface processes is to develop a coherent body of data on planetary surface processes which can be used to design planetary missions and to interpret data as well as boundary conditions on planetary evolution. The study of appropriate analogs not only places boundary conditions on the evolution of Mars but also permits on Earth the evaluation of the characteristics of Martian surface instrumentation. Future exploration of Mars and other planets includes surface analysis and sample return missions. The development of these missions requires suitable instrumentation for analyses on the surface of Mars and analogs of Martian surface material. Specific objectives are to characterize the gases released by thermal decomposition of Martian surface analog materials and evaluate the feasibility of accomplishing such analyses *in situ* and to simulate the mechanical, chemical and radiative weathering environments on Mars and study in detail the resulting products of materials subjected to such conditions.

W81-70484 155-50-01

Goddard Space Flight Center Greenbelt Md

DATA REPRODUCTION IN SUPPORT OF THE MARS DATA ANALYSIS PROGRAM

James I Vette 301-344-7354
(404-03-01)

The NASA Headquarters Planetary Division has approximately 110 Principal Investigators. Many of these, in addition to a number of other planetary scientists, will be participating in the Mars Data Analysis Program. Many of these investigators require large quantities of data, especially photographic products, to achieve

OFFICE OF SPACE SCIENCE

the objectives of their investigations. Such products are only generally available through the National Space Science Data Center (NSSDC). While the size of these NASA-supported requests would normally result in NSSDC's having to charge for services such funds from university and other nongovernmental investigators would go to the U.S. Treasury. Therefore these funds would not allow NSSDC to purchase the required photographic supplies or pay contractor labor. On the other hand the existing budget would not allow NSSDC to supply these investigators with required data and carry out its normal request activity. For example NSSDC has received approximately 45 000 feet of 5-inch film containing Viking images. A number of investigators will require a complete set of prints and negatives. These additional requests cannot be satisfied within the existing NSSDC budget.

W81-70485

Jet Propulsion Laboratory Pasadena Calif

MDAP GEOLOGY

David E. Thompson 213-354-6129

This RTOP supports two general aspects of Mars data analysis. First analog studies are carried out to understand processes and physical interactions occurring in the Martian surface environment. These tasks are theoretical, experimental and field analog in nature. Theoretical and experimental work is being carried out in the thermophysical and geochemical properties of Martian soil models. This information reconfirms or enhances our understanding and interpretation of Viking and Mariner radiometric observations. In addition, theoretical and field analog studies are being conducted on the geomorphic processes which shape the Martian outflow channels and the sediment transport relations operative in major catastrophic flooding events akin to those believed to have occurred on Mars. An examination of time dependent spatial behavior of albedo and thermal properties of the Mars south polar cap is being carried out by organizing ITM data into motion picture format to discover and monitor time dependent properties. All of this work is ultimately constrained and tied back to relevant Viking data both from landers and orbiters. The second aspect of this RTOP then is an effort to analyze the reliability of that data and to monitor changes at the lander sites. In particular, analysis includes estimated spectral reflectance as distinguishable from data noise and a major effort to identify and correct orbiter imaging errors to require and document imaging data and to maximize data-search techniques to make an accurate data base available to the scientific community.

155-50-01

W81-70487

Jet Propulsion Laboratory Pasadena Calif

INSTRUMENT DEFINITION

Albert E. Metzger 213-354-4017

This RTOP contains the following six tasks: (1) definition of the advanced gamma ray spectroscopy (2) alpha/X-Ray analysis using solid state detectors (3) definition of the central cooler for planetary experiments (4) comet thermal modeling (5) laboratory studies of gamma ray and X-Ray remote sensing techniques and (6) construction of an electron microprobe prototype for the analysis of cometary dust. The general objective of this program is the timely development of instruments and techniques to support future missions to solar system bodies.

157-03-01

W81-70488

Lyndon B. Johnson Space Center Houston Tex

INSTRUMENT DEVELOPMENT FOR SPACEFLIGHT EXPERIMENTS

J. L. Warner 713-483-4464

This RTOP is to initiate detailed development of experiments intended for planetary spacecraft. Specifically the Mass Spectrometry-Isotope Dilution (MSID) experiment (LE Hyquist PI) and Particle Imaging and Chemical Analysis (PICA) experiment (E.A. King Jr. PI) are included here. Proposals for both instruments were submitted in response to the AO for the International Comet Mission. The efforts are for detailed design studies both theoretical and experimental directed at solving problems that must be addressed before the final design effort starts. These are studies that must be completed early to assure a proper work flow in designing and fabricating flight hardware. The MSID experiment will divide its technical efforts between the mass analyzer and the Sample Processing System (SPS). These efforts will be carried out by both in-house experimental studies and by contracted studies with industry. The PICA experiment will divide its technical efforts between the electron optics system and the technology of high voltage on spacecraft. These efforts will be carried out by both experimental and theoretical studies at the University of Houston and by contracted studies with industry.

157-03-40

Instrument Development

W81-70486

157-01-01

Jet Propulsion Laboratory Pasadena Calif

ADVANCED CCD CAMERA DEVELOPMENT

J. R. Janesick 213-354-7734

Previous work on visual Charge Coupled Devices (CCD) development has led to the current activity to provide 800x800 element devices for several space flight imaging programs. These devices look like they will perform well but have several limitations that currently restrict their use. A new device technology has been developed recently that presents an opportunity to overcome some of the most significant limitations of the current 800x800 CCD and at the same time allow the development of even larger array devices. This single phase CCD approach has already been demonstrated and is currently ready for development as a scientific sensor. The activity to develop the chip is being supported by the Office of Aeronautics and Space Technology (OAST). However, to both evaluate the device and develop the supporting electronics expertise required in advance of flight mission use a camera development activity is needed. This camera development will happen in conjunction with the device development and will provide the initial electronics design, the camera testing and the camera/CCD characterization needed for both effective chip development and future imaging mission support. The need for large area device CCD's cameras continues to grow and the performance and producability of the current devices is limited. This camera development will open up availability to a much larger community and provide a larger area device.

W81-70489

157-03-50

Goddard Space Flight Center Greenbelt Md

X-RAY, GAMMA-RAY AND NEUTRON GAMMA-RAY METHODS FOR PLANETARY EXPLORATION

J. I. Trombka 301-344-5941

The objective of this investigation is to develop instrumental systems and obtain cross sections for remote measurements of the spectra X-ray, gamma ray and neutron-gamma-ray emission from planetary asteroid and cometary bodies. These measurements will be used to obtain geochemical and geophysical information concerning such planetary bodies. The X-ray spectrometer study will consider both proportional and solid-state detectors. Elemental composition for elements with atomic numbers greater than $z = 6$ (carbon) using solar X-ray fluorescent spectral measurements are being considered. Both theoretical and experimental studies will be used in the investigative program. Gamma-ray fluxes produced by electron acceleration by ionosphere-solar wind interactions and by crossing sector boundaries will be calculated. The temporal and energy distributions and the flux intensities will be estimated. A major problem in the interpretation of gamma-ray spectroscopic data with respect to chemical analysis of planetary bodies is the lack of information on cross sections and discrete line gamma-ray emissions from certain key elements (e.g. C, O and H). Both theoretical and experimental studies will be used to obtain this information. Furthermore with improved cross sections and spectral data neutron and gamma-ray transport calculations will be carried out to better understand the expected gamma-ray emission from planetary asteroids and cometary surfaces. This work would be performed in cooperation with groups at UCSD, JPL and LASL.

Solar Terrestrial SR&T**W81-70490**

Marshall Space Flight Center Huntsville Ala

PARTICLE AND PARTICLE FIELD INTERACTIONS

C R Chappell 205-453-3036

(385-36-01)

The objectives of this RTOP are to develop space plasma instrumentation for automated spacecraft sounding rocket and shuttle payloads. To accomplish these objectives the following tasks will be performed (1) Complete the development of four Differential Ion Flux Probes (DIFP) to be used for the measurement of multiply-directed low-energy ion streams. This technique has been applied in laboratory wind tunnel studies and will be used on two rocket flights into the polar cusp in 1981 (2) Continue the design of a Swept Angle Retarding Ion Mass Spectrometer (SARIMS) for the measurement of low-energy plasma distributions in the ionosphere and magnetosphere. This instrument was flown on a mid-latitude sounding rocket in the fall of 1979 and on a high latitude auroral rocket in March 1980. The instrument will be upgraded for potential flight on future NASA and DOD mission (3) Begin development of instrumentation techniques for the measurement of visible UV and near IR emission generated in the aurora and in electron beam experiments

W81-70491

170-36-55

Ames Research Center Moffett Field Calif

MAGNETOSPHERIC PHYSICS - PARTICLES AND PARTICLE/FIELD INTERACTION

A Barnes 415-965-5506

(384-47-67 385-36-01)

The objective is to improve understanding of the dynamics origin and termination of the solar wind turbulence in the solar wind and to investigate possible effects of solar and interplanetary phenomena on terrestrial weather and climate. Theoretical studies will be conducted aimed at understanding the large-scale dynamics of the solar wind its acceleration and heating mechanisms and waves and turbulence in the solar wind. These studies employ known theoretical techniques of plasma physics and magnetohydrodynamics, and also often require extensions of basic theoretical plasma physics. Theoretical developments will be related to spacecraft plasma and magnetic data as well as to indirect observations of the solar wind. Theoretical studies of possible relations between variations in solar output (radiation and/or charged particles and magnetic fields) and terrestrial weather and climate will be carried out

W81-70492

170-36-55

Goddard Space Flight Center Greenbelt Md

PARTICLES AND PARTICLE/FIELD INTERACTIONS

Keith W Ogilvie 301-344-5904

The object of this research is to increase the knowledge and understanding of non thermal plasmas occurring in the interplanetary medium and magnetospheres of planets. This requires continuous improvement of measurement techniques concentrating on advanced concepts for plasma detectors magnetometers and radio and plasma wave analyzers. Work is also under way to improve the theoretical description of plasma properties, and to improve techniques for the interpretation of the results of appropriate space experiments requiring corresponding improvements in numerical techniques and in methods of data display

W81-70493

170-36-56

Goddard Space Flight Center Greenbelt, Md

PARTICLE AND PARTICLE/PHOTON INTERACTIONS (ATMOSPHERIC-MAGNETOSPHERIC COUPLING)

James P Heppner 301-344-8797

The objective is to develop experimental and theoretical approaches for investigating and understanding the processes which provide strong coupling between the neutral atmosphere the collision dominated ionospheric plasma and the collisionless magnetospheric plasma. Within the framework of this overall objective, specific sub objectives are identified in terms of having

(1) key significance (2) goals which are attainable with limited resources, and (3) close ties to future projects and programs. Emphasis is placed on the primary forces electric fields and neutral winds and the associated transport and energization of particles. Related topics include electric fields in the earth-ionosphere cavity and their relation to weather processes electric current systems and associated magnetic field disturbances the generation of thermospheric winds and gravity waves atmospheric chemical composition anomalies the transformation of atmospheric ions to trapped radiation auroral particle acceleration mechanisms plasma instabilities producing ionospheric irregularities etc. New instrumentation is being designed and developed for observations of tracer chemicals and for measurements of low energy particles. Properties of double probes in low density plasma are being studied with the SCATHA satellite. Models for the diffusion of tracer particles are to be developed for planning future chemical release experiments. The closure of magnetospheric electric fields within the earth-ionosphere cavity is to be studied in support of low and middle atmosphere electric field investigations

W81-70494

170-36-57

Goddard Space Flight Center Greenbelt Md

PARTICLE ACCELERATOR FACILITY MAINTENANCE AND OPERATION OF A CALIBRATION FACILITY FOR MAGNETOSPHERIC AND SOLAR-TERRESTRIAL EXPERIMENTS

James H Trainor 301-344-6282

The GSFC Sciences Directorate operates a nuclear particle calibration facility consisting of a 2 MeV Van de Graaf and a 250 keV electrostatic accelerator. The facility provides particle energies from 50 eV to 2 MeV and protons via reactions to approximately 20 MeV. Particle beams available range from electrons to Kr84 with fluxes from approximately 1 particle/sq cm sec to approximately 10 to the 9th power particle/sq cm sec. It has been a unique facility in the world in this low energy region. Some of its abilities are now duplicated by an accelerator at MPI Lindau. For several years all work in this facility has been in support of magnetospheric and solar-terrestrial research. Over the period FY-77 through FY-79 machine time has been split fairly evenly between calibration and testing of satellite experiments testing and development of new particle detector systems and numerous sounding rocket payloads. Requests from foreign experimenters amount to 5 to 15% of the machine time. The facility operates normally on all working days but the requirements of the experimenters in the past several years have often required operation 6 or 7 days per week and 12-16 hours per day at times. That coupled with the declining manpower in Code 660 has forced the facility to rely heavily on contractor manpower for maintenance and operation

W81-70495

170-38-51

Marshall Space Flight Center Huntsville Ala

DEVELOPMENT OF EXPERIMENTS AND HARDWARE FOR SOLAR PHYSICS RESEARCH

M J Hagyard 205-453-0118

The objective of this program is to develop an engineering design of a flight experiment to measure very small variations in total solar flux as a new technique for critical study of the dynamics of convection and magnetic fields in the solar convection zone. The approach is through development of an instrument a crystal cavity radiometer (CCR) which uses the extreme stability of oscillation of a quartz crystal as a sensitive indicator of changes in solar irradiance

W81-70496

170-38-51

Goddard Space Flight Center Greenbelt Md

DEVELOPMENT OF SOLAR SPACELAB EXPERIMENT AND HARDWARE

Robert D Chapman 301-344-5101

The objective is to develop payloads which contribute to the solution of well-defined solar research problems. These activities have the ultimate objective of flying payloads on problem-oriented shuttle-Spacelab missions. In such missions a payload of instruments is assembled to provide by simultaneous observations of a phenomenon such as solar flare or the outflow of the solar wind at the base of the corona the thorough detail

OFFICE OF SPACE SCIENCE

meeded for a cogent model of that phenomenon. As an example of such a mission is SMM for solar flare research. This spacecraft will be retrieved by the shuttle and flown again with refurbished instrumentation. This and other research problems will form bases for series of missions using the shuttle. One of these will be a study of coronal structures contributing to the solar wind and the interplanetary plasma. A second will be a study of the sources of high energy particles on the Sun emphasizing instrumentation not accommodated by and/or supplementary to the SMM Instruments. Missions emphasizing the phenomenon of coronal heating and mass and energy balance in the chromosphere are also contemplated. In each case a number of different instruments covering a wide range of wavelengths is required. These will be selected on the basis of making comprehensive measurements in their specific wavelength regions in a format coordinated with and complimentary to the other instruments in the payload. For example all instruments will operate with the same temporal and spatial resolution to the maximum possible extent.

W81-70497

170-38-52

Goddard Space Flight Center Greenbelt Md

GROUND-BASED OBSERVATIONS OF THE SUN

Robert W Hobbs 301-344-7591

The major objective is the measurement of solar radiation at those wavelengths accessible from the ground with resolution (spatial spectral temporal velocity) suitable for supporting investigations of solar phenomena (flares active regions wave motion velocity fields and magnetic fields) carried out in the EUV X-rays and gamma rays by Solar Maximum Mission and other flight missions in the NASA Solar Physics Program and for basic research on the Sun. Another objective is the analysis of comet tail photographs to determine the velocity field of the solar wind. Several observatory facilities are supported and maintained for this purpose. The Laboratory provides support for the Vacuum Tower Telescope at Kitt Peak which specifically provides HeI 10830A spectroheliograms and magnetogram.

W81-70498

170-38-52

Marshall Space Flight Center Huntsville Ala

GROUND-BASED OBSERVATIONS OF THE SUN

M J Hagyard 205-453-0118
(385-38-01)

The objective of this research is a program of ground-based observations for basic research concerning solar vector magnetic fields and for support of NASA solar missions using the facilities of the MSFC Solar Observatory. In the program for basic research a theoretical and observational program will be initiated to study magneto-optical effects in the interpretation of filter vector magnetograph data. An upgrading program for the MSFC vector magnetograph system will be undertaken to provide an optimal system for support of NASA solar missions in the mid-80's and beyond.

W81-70499

170-38-53

Goddard Space Flight Center Greenbelt Md

EXPERIMENT DEVELOPMENT - LABORATORY AND THEORETICAL SOLAR PHYSICS

Robert D Chapman 301-344-5101

The primary objective is to support the laboratory's on-going programs by developing fundamental experimental and theoretical techniques that are applicable to the analysis of returned data. The specific goals are to (1) correctly interpret the nature of observable solar phenomena by understanding fundamental spectroscopic processes and (2) understand these phenomena with regard to the flow of mass energy and momentum from a mechanical energy reservoir such as the convection zone to the chromosphere and corona. Major emphasis is given to (1) processes that result in a conversion of mechanical energy associated with photospheric velocity fields into a nonthermal energy flux (e.g. an acoustic flux Poynting flux etc.) (2) processes that result in and control the propagation of this nonthermal energy from its point of generation within the photosphere to the chromosphere and corona (3) processes that result in the irreversible conversion of this energy into thermodynamic end products within the chromosphere and corona (4) processes that control the subsequent dispersal of these thermodynamic

end products throughout the chromosphere and corona (e.g. thermal and nonthermal diffusion) (5) consolidation of the above processes (1)-(4) into models that predict new solar phenomena and explain those already observed. With regard to the above the emphasis is given to the identification of spectral lines in high energy spark discharges the calculation of atomic transition probabilities and studies of atomic collision processes in solar plasmas.

Advanced Studies

W81-70500

171-03-00

Goddard Space Flight Center Greenbelt Md

ORIGINS OF PLASMA IN THE EARTH'S NEIGHBORHOOD (OPEN)

G W Longanecker 301-344-7751

The objective of this RTOP is to develop the scientific and technical basis for a solar terrestrial multi-satellite mission to be proposed for flight in FY-85 to FY-86. The objective of this mission is to provide simultaneous coordinated measurements of the role of plasmas in the transport storage and dissipation of energy in the solar wind and the terrestrial magnetosphere. The approach is to conduct preliminary system design studies (feasibility) in the areas of sensors and/or instrument requirements design mission analysis system definition and design and ground data processing systems to meet requirements established by the Solar Terrestrial Program Office and its appointed science working group. These studies form the basis for the request for proposal requesting alternate system design concepts from industry as the next step in the OMB Circular A-109 procurement process.

Astrophysics SR&T

W81-70501

188-41-51

Marshall Space Flight Center Huntsville Ala

UV AND OPTICAL ASTRONOMY

C R ODell 205-453-3033

An observational and interpretative program of astronomical spectroscopy will be pursued using the Echelle grating nebular spectrograph. This will include a program of observations and data interpretation concerning internal velocities in HII regions. Identified and candidate optical counterparts to high energy sources will be observed with the objective of providing a more complete understanding of the nature and distribution of the high energy sources. Methods of high time resolution photometry spectrophotometry and polarimetry will be applied utilizing among other observational equipment the video detector systems and photon counting equipment. The observations will also include selected cataclysmic variables not now known to be X-ray sources. A program to observe stars in selected R associations will employ broadband visual and infrared photometry spectroscopy and infrared mapping. The facilities at Kitt Peak the University of Wyoming, and other observatories will be utilized.

W81-70502

188-41-51

Goddard Space Flight Center Greenbelt Md

UV AND OPTICAL ASTRONOMY

A Boggess 301-344-5103

The objective is to pursue a long range program in astronomical research with emphasis on optical observations theoretical astrophysics and other specific topics of special interest to NASA. The effort includes operation of ground telescopes, development of new instrumentation for ground and potential space application data interpretation and theoretical studies. Spectroscopic and photometric data are obtained from ground telescopes in order to analyze the properties of stellar atmospheres nebulae the interstellar medium, and galaxies. Nonequilibrium model atmospheres are being investigated to interpret spectral observations from space and ground observatories. Theoretical investigations are carried out in formation and evolution of galaxies and on the evolution of stellar interiors variable stars novae and planetary nebulae.

W81-70503

188-41-51

Ames Research Center Moffett Field Calif

THEORETICAL STUDIES OF GALAXIES, ACTIVE GALACTIC NUCLEI, AND QUASI STELLAR OBJECTS

L J Caroff 415-965-5536

The objective is to conduct theoretical studies on important

fundamental problems in the formation and evolution of galaxies and in the structure and dynamics of OSOs and active galactic nuclei. Much of the effort falls under the aegis of computational astrophysics making use of existing numerical codes for hydrodynamics and radiative transfer as well as developing new ones. An important aspect of this area of study is the development of a general method for modeling random phenomena which has wide application to many areas of astrophysics.

W81-70504 **188-41-54**
Goddard Space Flight Center Greenbelt Md
FIBER-OPTICALLY MOSAICED LARGE AREA IMAGE SENSORS

Kenneth Hallam 301-344-8701

The objective of this task is to develop and demonstrate the means by which a number N of individual solid-state optical-input mode charge transfer type (CCD CID) image detection devices may be optically-mosaiced to form a single sensor which will detect an image area N -times larger than any single one. In many astronomical systems the optical information throughput limit is still set by the detector system rather than by the optical system per se. This is especially true where optical scenes carry the required information content to be extracted by image detectors. In most cases, the image detector system lacks the analytical capacity to fully utilize the information throughput obtainable with today's optical design and/or technology for telescopes and spectrographs. This task is addressed to develop and demonstrate a generally practical and economical means by which existing optical image detectors with limited scene resolvability can be optically combined or mosaiced to detect scenes several times larger than individually possible while preserving or enhancing its other performance characteristics.

W81-70505 **188-41-55**
Goddard Space Flight Center Greenbelt Md
INFRARED AND RADIO ASTRONOMY

M J Mumma 301-344-6993

The scientific objective of this program is to provide better understanding of the energetics dynamics compositions excitation conditions and evolution of solar system objects stars proto-stars dust clouds HII regions galactic emissions and extragalactic objects. This is achieved by observations of these objects at wavelengths from 1 micron - 10 cm and at spectral resolutions ($\lambda/\Delta\lambda$) from approximately 1 to approximately 1 000 000. Since atmospheric opacity and emissivity prohibit or severely limit ground-based observations at certain wavelengths (4-8 microns and 13-700 microns) high altitude observational platforms such as the C-141 balloons or satellites must be used. High sensitivity composite bolometers are being developed in the far infrared to take maximal advantages of low background conditions achievable at these altitudes. A balloon-borne 1.2m telescope is being developed to conduct a high sensitivity low spatial resolution multicolor photometric survey of Galactic sources of submillimeter radiation and at least a partial survey of extragalactic sources at these wavelengths. Infrared and millimeter/sub-millimeter coherent (heterodyne) spectrometers are developed and used to measure completely resolved intensity profiles for neutral and ionized molecular and atomic lines.

W81-70506 **188-41-55**
Ames Research Center Moffett Field Calif
THEORETICAL INFRARED AND RADIO ASTROPHYSICS

D C Black 415-965-5495

The objective of this work is to conduct theoretical studies on fundamental problems in astronomy and astrophysics with emphasis on phenomena susceptible to observational study of infrared and/or radio wavelengths. Emphasis will be placed on studies of star formation and on studies of the structure dynamics and evolution of dark molecular clouds. There will also be theoretical studies aimed at determining the vibration-rotation line strengths for the ground electronic states of the CO OH and SiO molecules including all of their isotopic variants.

W81-70507

188-41-55

Jet Propulsion Laboratory Pasadena Calif

RADIO ASTRONOMY

Samuel Gulkis 213-354-5708

(188-41-51 358-78-60 540-01-15)

In the observations task we are continuing a program of ground-based millimeter wave spectroscopy using the new 10-m antennas at the Owens Valley Radio Observatory (OVRO). The 1.7 mm receiver which assembled and operated in 1978 will be employed in observations of SiO H2S and weather permitting HCN. We also hope to expand the operating range towards 150 GHz (for H2CO when weather prevents higher frequency operation) and into the 200 to 300 GHz range. We plan to continue observations of interstellar molecules with the Kuiper Airborne Observatory (KAO) and of galaxies planetary nebulae and extended HII regions with the Deep Space Network (DSN). The laboratory task will expand a program of millimeter and submillimeter measurements of molecules of astrophysical interest and when the catalogue work indicates a deficiency in the existing data. The catalogue of transitions of astrophysical molecules which now comprises 122 atomic and molecular species has been released to the community. Emphasis is now focussing on the measurement and computation of molecules of high interest for submillimeter astronomy such as CH2 NH2 NH and similar radicals. In the Tidbinbilla interferometer task we propose to carry out position measurements on a variety of weak radio sources in the Southern Hemisphere. The interferometer utilizes the 34 m and 64 m antennas of the Deep Space Network near Canberra Australia. It is the most sensitive interferometer in the southern hemisphere. Using this instrument we plan to develop a catalogue of precise positions with an ultimate view to obtaining optical identifications. Prerequisite calibration measurements and software development have been completed. In the K-band Maser task we plan some limited development analysis of the results of the first balloon flight to measure the isotropy of the cosmic background radiation. We anticipate additional flights in FY-81. The pulsar rotation constancy task uses DSN stations to monitor a select set of pulsars to measure the rate of spin-down and to document discrete changes in the pulse repetition rate as input to theoretical studies on period instabilities. Pulsar timing data are also used to determine precise positions and motions of pulsars.

W81-70508

188-46-56

Marshall Space Flight Center Huntsville Ala

PARTICLE ASTROPHYSICS

T A Parnell 205-453-5133

The program consists of observations and interpretation of data to determine the origins and source mechanisms of heavy cosmic ray nuclei ($4 < Z < 2$) and cosmic gamma rays between 0.1 and 10 MeV. Emphasis is also placed on the improvement of instrumentation and data analysis techniques for further measurements of these particles and for application to Spacelab-era experiments. Observations of the nuclei and gamma rays are performed on balloon flights and measurements of detector response are made in the laboratory and at particle accelerators. Calculations concerning sources of particles local background and detector response are carried out and verified by measurement.

W81-70509

188-46-56

Goddard Space Flight Center Greenbelt Md

PARTICLE ASTROPHYSICS AND SHUTTLE EXPERIMENT DEFINITION

F B McDonald 301-344-8801

The objective is to study the properties of the cosmic radiation in order to understand its origin and propagation and to study the properties of the sites in which element synthesis takes place. The particles observed are the nuclear and electronic species of the cosmic ray particles. Their energy spectra, their charge and isotopic composition and their distribution in space. Some of these objectives can be met through the imaginative use of short duration observations on balloons. Many will require heavier larger-area payloads for which the space shuttle will be an ideal observation platform especially in the sortie mode. The details of the chemical composition of the particles as a function of energy is intimately related to the propagation process and must

OFFICE OF SPACE SCIENCE

be completely understood in order to determine the cosmic ray path length distribution and hence, the spatial distribution of cosmic ray sources. In addition this will determine the injection spectrum of cosmic ray nuclei. The high energy composition measurements are essential in order to determine the source abundances of the rarer cosmic ray nuclei. Isotopic composition will enable us to probe the nucleosynthesis going on in the cosmic ray sources. The observation of enhanced Ne22, first reported by our group and now being confirmed by others is a prime example of the nonsolar nature of cosmic ray material

W81-70510 **188-46-57**
Goddard Space Flight Center Greenbelt Md
GAMMA RAY ASTRONOMY
C E Fichtel 301-344-6281

The technical objective is to develop the most appropriate detector systems for the observation of the astrophysical sources of very energetic photons. The first approach was the development of a large high energy telescope using digitized spark chambers. Many major improvements to this basic telescope system are still being pursued and other approaches to detector systems are now being developed for the high energy intermediate energy and low energy gamma ray observations. In the medium energy interval (8 to 50 MeV) a second generation experiment is now ready for a balloon flight. In the 1/2 to 40 MeV region different detection processes become dominant and hence new detector techniques are required. A totally new detector is currently being developed based on the Compton interaction process. In the 0.03 to 10 MeV region much of the radiation may consist of monoenergetic line components. Therefore high resolution spectrometers are also being developed which will be capable of sufficient precision to resolve lines as narrow as may be found in nature. In the high energy region improvements in the track imaging chamber systems are continuing and special attention in the track imaging chamber research is now being directed towards drift chambers and larger spark chambers. At the same time several approaches are being explored to improve angular resolution including techniques to concentrate on higher energy photons. Improved attitude and aspect systems are being built

W81-70511 **188-46-57**
Jet Propulsion Laboratory Pasadena Calif
GAMMA-RAY ASTRONOMY
A S Jacobson 213-354-6263

This RTOP describes the JPL program in X- and gamma ray astronomy part of which is a cooperative effort with the Space Radiation Laboratory on the CIT campus. The primary objective of the program is to observe nuclear gamma-ray line spectra from extraterrestrial sources in the 0.2 to 10 MeV energy range. Such observations will provide important information on nucleosynthesis, galactic structure and the physical nature of various celestial objects including cosmic X-ray and gamma-ray sources both constant and transient. Under this program analysis of data from a previous balloon flight will be completed and published. Additionally development of a new significantly larger balloon system will continue. The specific objectives for this program for FY-81 are to continue the design of the next generation high spectral resolution gamma-ray telescope and to continue with the procurement of large volume high purity germanium crystals.

W81-70512 **188-46-59**
Marshall Space Flight Center Huntsville Ala
X-RAY ASTRONOMY - TIME VARIABILITY AND POLARIMETRY
M C Weisskopf 205-453-5133

The objective is to conduct research in the field of X-ray astronomy in areas related to the Astrophysics programs of NASA in the following tasks: (1) We will analyze and interpret existing satellite and ground-based observations of the time variability of the X-ray sources and their optical counterparts with emphasis on the black hole candidates. Auto- and cross-correlation techniques, shot model and pulse-shape-innovation techniques will be utilized to determine the underlying pulse shape and stability as a function of time. (2) We will determine the degree

of the contamination of the OSO-8 X-ray polarization data by solar X-rays polarized due to electron scattering. This task will be accomplished by correlating solar intensity measurement obtained with an X-ray heliometer also aboard the satellite. (3) We will design, build, test and fly in a sounding rocket an advanced X-ray polarimeter. The polarimeter will utilize the polarization dependence of the photoelectric effect and in particular the angular dependence of certain fluorescence photons on the linear polarization of the incident X-rays.

W81-70513 **188-46-59**
Goddard Space Flight Center Greenbelt Md
X-RAY ASTRONOMY
E A Boldt 301-344-5853

Celestial X-ray sources have introduced us to rich new aspects of astronomy ranging from the millisecond bursts of hard X-rays coming from the innermost orbits of matter falling into a black hole to the beamed emission associated with accretion of matter onto a rapidly rotating highly magnetized neutron star. The combination of large sensitive area, low detector background, high temporal resolution and nondispersive spectroscopy over a broad bandwidth has been our approach in discovering and exploring these phenomena. The power of this approach is being well demonstrated. Extending it with improved spectral resolution and broadband imaging is a major area of development now indicated. This involves the creation and evaluation of new systems incorporating low noise ionization counters to optimum resolution, large area X-ray concentrators and imaging devices such as CCD's. Dispersive spectroscopy is introduced via the development of a conical crystal spectrometer.

W81-70514 **188-46-51**
Marshall Space Flight Center Huntsville Ala
INTERDISCIPLINARY SPACE SCIENCE RESEARCH
C R ODell 205-453-3033

The objectives are to conduct space science research in various scientific and technical disciplines related to the astrophysics programs of NASA and to provide a quick-reaction capability of supporting research tasks unforeseen or which encounter unexpected difficulties and which enhance the in-house scientific capabilities of the MSFC. Under the direction of the Associate Director for Science research is initiated in astrophysics-related scientific and technical areas that support the scientific missions of the Center. Research tasks selected for funding will contribute to the advancement of in-house capabilities and the state-of-the-art.

W81-70515 **188-78-51**
Marshall Space Flight Center Huntsville Ala
LOW GRAVITY SUPERFLUID HELIUM ADVANCED TECHNOLOGY DEVELOPMENT
R Decher 205-453-5130

Several experiments are currently being developed which will require a low temperature environment for their proper operation in space. Superfluid helium will undoubtedly be used for many of these applications. Immediate application to experiments are to be found in cosmic ray relativity and infrared astronomy. The purpose of this RTOP is to investigate theoretically and experimentally where possible the properties of superfluid helium to be expected when liquid helium dewars are flown into space. The properties of superfluid helium in this near zero gravity environment will be assessed and methods will be investigated whereby problem areas may be resolved and/or controlled. The goal of this effort is to support the development of liquid helium dewar technology for space.

W81-70516 **188-78-51**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED TECHNOLOGICAL DEVELOPMENT, GENERAL SIGNAL AND DATA PROCESSING ELECTRONICS, SOLID STATE DETECTORS
James H Trainor 301-344-6282

The objectives of this research project are to develop and test new on-board signal handling, data processing, storage, computing and auxiliary electronics circuitry for use in energetic particle and astrophysics experiments on spacecraft rockets.

balloons etc as well as special test and analysis equipment applicable also for both ground and shuttle usage The growing complexity of experiments and the often corresponding increase in the volume of data obtained have made signal handling data processing and data transmission capability-limiting factors To reduce the transmission of unnecessary data it is necessary to increase the experiment's on-board signal handling and data processing capability This program is approached through the investigation and development of new techniques for signal shaping and handling data processing and auxiliary circuitry and the modification of existing techniques by the application of advanced technology and materials including MOS/LSI technology thick film techniques multiple chip techniques and microprocessors The technical objective of the research project is to conduct a program of research and development and device test and evaluation in the field of silicon and germanium nuclear radiation detectors with emphasis on (1) the improvement of detector technology (2) the understanding of the radiation damage effects on device operation and lifetime (3) the understanding of the effects on these detectors of chemicals commonly used near or on spacecraft (4) to establish the technology for the fabrication of specialized devices not available from industry and (5) to continue the pragmatic life testing

W81-70517 **188-78-60**
Marshall Space Flight Center Huntsville Ala
ADVANCED MISSION STUDIES
C C Dailey 205-453-4024

This RTOP covers studies related to astrophysics missions for the exploration of the electromagnetic radiation from space Examples are Advanced X-Ray Astrophysics Facility (AXAF) and other missions designed for X-ray research and the Optically Coherent Telescope Array for detail studies in the visible portion of the spectrum using extremely large arrays of reflectors Other studies in the area described by this RTOP will be incorporated as separate tasks as appropriate

Planetary Astronomy SR&T

W81-70518 **196-41-30**
Marshall Space Flight Center Huntsville Ala
COMETARY OBSERVATION AND THEORY
C R O Dell 205-453-3033
(188-41-51)

The objective is to obtain cometary spectra with intermediate spectral resolution between 350 to 820 nm with emphasis on the longer wavelength and to analyze rovibronic structure of the observed comets and spectra of comets in terms of a corrected resonance-fluorescence mechanism An Echelle spectrograph employing an S-20 fiber optics image tube with an F/2 Schmidt camera will allow a spectral resolution of approximately equal to 0.5 Angstrom to be obtained on photographic plates Standard data reduction by densitometry will be employed A review of laboratory and cometary spectra will provide the initial suggestions for correcting the resonance-fluorescence mechanism (e.g. NH₂)

W81-70519 **196-41-40**
Lyndon B Johnson Space Center, Houston Tex
REMOTE SENSING OF PLANETARY SURFACES
A E Potter 713-483-5039

The objectives are to (1) identify and map silicates on the lunar surface, using silicate reststrahlen bands in the thermal emission spectrum of the Moon and to extend this approach to identification of silicates in comets and asteroids near the Sun and (2) to develop and apply instrumentation for multispectral imaging of the lunar surface at 32 bands in the 0.8-2.4 micron spectral range Current techniques obtain this data for only one site at a time making geologic mapping from spectral information a slow and difficult process Initial studies of the lunar reststrahlen bands have been done with a high resolution Michelson interferometer in order to locate the bands accurately and to

obtain simultaneous water vapor and ozone data needed for atmospheric corrections A low-resolution spectrometer operated along with a water vapor and ozone meter would provide equivalent data with improved sensitivity and speed and this system will be built to replace the interferometer A linear array of lead sulfide infrared detectors to give spatial resolution is operated with a Michelson interferometer to give spectral resolution in the 0.8-2.4 micron spectral range Thirty two bands in the 0.8-2.4 micron range are produced by the current configuration Imagery can be produced by stepping the array over the lunar surface perpendicular to its long dimension

W81-70520 **196-41-50**
Goddard Space Flight Center Greenbelt Md
GROUND-BASED INFRARED ASTRONOMY
V G Kunde 301-344-5693

The scientific objective is to determine information on astrophysical objects such as molecular clouds interstellar lines molecular and circumstellar components in stellar atmospheres and planetary atmospheres from high spectral resolution ground-based measurements in the intermediate infrared A spectrometer system employing a cryogenic Michelson interferometer (77K) is being developed to meet the simultaneous requirements of high spectra resolution a wide free spectral range and high sensitivity An optical retardation up to 25 cm will provide an unapodized spectral resolution up to 0.2/cm in the 400-2000/cm range A post-dispersed detection system is being developed to reduce background noise from a warm telescope system and the atmosphere at the detector thus allowing the multiplex advantage of the interferometer to be retained The cooled instrumentation with the post-dispersed detection system operating at a favorable infrared site will allow maximum sensitivity to be attained for an interferometer system at a ground-based site The sensitivity level for a measurement in the 1000/cm (10 microns) region with a 122 cm diameter telescope an integration time of 60 minutes and a spectral resolution of 0.2/cm is approximately 5 x 10 to the minus 26th power watts/sq m/Hz The s/n level for Jupiter in the 1000/cm region with the above system is approximately 7 for one minute integration time and full spectral resolution of 0.02/cm Initial observations will be made during FY 81 with a discrete detector system with sensitivities approximately 5-10 lower than for the post-dispersion system

W81-70521 **196-41-51**
Goddard Space Flight Center Greenbelt Md
RADIO AND RADAR PLANETARY STUDIES
J K Alexander 301-344-5461

The objective of this program is to obtain information on the nature extent and dynamical behavior of planetary magnetic fields trapped radiation belts and magnetospheres by studying the nonthermal radio emissions from the planets The major approaches to this investigation are (1) synoptic observations of Jupiter's decametric radiation via a global network of monitoring instruments and (2) theoretical analysis of the generation and propagation of nonthermal radiation in a planetary magnetosphere The Jupiter Monitor Network has provided unique data relative to the rate and stability of the magnetic field rotation energetic particle trapping and precipitation processes and the physics of the satellite-plasma interactions in the magnetosphere and correlative data both for other ground-based observations and fly-by in-situ measurements

W81-70522 **196-41-52**
Goddard Space Flight Center Greenbelt Md
IMAGING STUDIES OF COMETS
John C Brandt 301-344-8701

This project provides for the operation of a small high altitude observatory Joint Observatory for Cometary Research (JOCR) for imaging research on comets and their interactions with solar radiation and the solar wind This research is carried out with ground-based images alone or if suitable data from spacecraft such as Solar Polar Mission is available with an appropriate combination of ground-based measurements It should be noted that funding provides support for the operation of the observatory only analysis of research results is funded

OFFICE OF SPACE SCIENCE

by the interested Program Office. In addition, when suitable bright comets appear radio observations will be made at existing national facilities and other visible wavelength observations will be carried out at other suitable facilities. The observatory site in central New Mexico is one of the darkest sites left in the continental U.S. Extensive photography of comets Kohoutek, Kobjoski-Berger-Milon and West has been carried out. These photographs show extensive features in the plasma 0.1 au from the head which have been analyzed for phase speed and estimates of the tail magnetic field. A structure in comet Kohoutek on January 20, 1974 was associated with a specific excursion in the polar solar-wind speed. This is a first.

W81-70523 **196-41-54**

Goddard Space Flight Center Greenbelt Md

ADVANCED INFRARED ASTRONOMY AND LABORATORY ASTROPHYSICS

M J Mumma 301-344-6994
(188-41-55 154-50-80)

The objective of the advanced infrared astronomy program is to study the molecular constituents of solar system objects (e.g. planetary atmospheres and comets) through observations of their IR line spectra and so to further our knowledge about (1) molecular abundances (2) kinetic vibrational and rotational temperature distributions (3) kinetic velocity shifts (winds) (4) vertical and spatial distributions and (5) ambient gas densities and to carry out comparative studies of these projects. The physical information sought is contained in the intensity profiles of isolated spectral lines and can be obtained by inversion of the observed line shapes. The measurement of spectral line shapes has recently become a tractable problem at IR wavelengths and line shapes can now be measured by infrared heterodyne spectroscopy. The approach is to develop and employ coherent detection line receivers for use in the infrared wavelength regions. The infrared optics incorporate either gas lasers or semi-conductor diode lasers as local oscillators and HgCdTe photo-mixers. The intermediate frequency signal is fed into a GSFC standard spectral line receiver which analyzes, displays and outputs the spectral lines. Initial observations with this system have been from the ground but it has been developed with an eye toward flights on the NASA C-141 and in space. Laboratory work on precise line frequency determinations and on pressure broadening effects is also carried out in support of the field experiment (see also RTOP 188-41-55 and 154-50-80).

W81-70524 **196-41-68**

Ames Research Center Moffett Field Calif

DETECTION OF OTHER PLANETARY SYSTEMS

D C Black 415-965-5495

The long-range objective of this activity is to develop a comprehensive program to detect other planetary systems. The near-term objectives include the funding of selected university researchers to pursue modest exploratory developmental and observational programs as well as theoretical studies directed at identifying optimum techniques for ground-based planetary detection systems. The choice of university researchers will be based on a peer review of unsolicited proposals and it will be guided by the basic recommendations set forth in Volume 1 of NASA CP-2124. Funding will also be used to support in-house theoretical research at Ames Research Center related to the detection and study of other planetary systems.

W81-70525 **196-41-71**

Jet Propulsion Laboratory Pasadena Calif

OPTICAL ASTRONOMY

T V Johnson 213-354-7427

The overall objective of the ground-based optical astronomy task is physical study of planets and their satellites by means of ground-based observations at visible and near-infrared wavelengths (approximately 0.3 to 2.0 μ m). This task consists of several subtasks: (1) investigation of the physical and chemical properties of the upper tropospheres of Venus, Jupiter, Saturn, Uranus and Neptune through high resolution astronomical spectroscopy and spectrophotometry; (2) investigation of the physical state and bulk motions of the neutral sodium cloud associated with Io through a variety of advanced high resolution

spectroscopic techniques and investigation of the temporal and spatial behavior of the Na D-line emission from the Jovian satellite Io (J-1) through a synoptic program of spectroscopic observations; and (3) investigation of the temperature and density of low energy thermal ions in Jupiter's magnetosphere. In addition to these primary subtasks the ground based optical astronomy task provides limited operational support (equipment maintenance and setup, observing assistance) at Table Mountain Observatory (TMO) to programs supported from other sources.

W81-70526

196-41-72

Jet Propulsion Laboratory Pasadena Calif

INFRARED ASTRONOMY

R Beer 213-354-4748

The objective of this program is to understand the physical and chemical state of planetary atmospheres by means of chemical and isotopic abundance analyses as determined by spectroradiometric remote sensing methods in direct support of ongoing and planned planetary missions. The principal approach employed is that of high-resolution near infrared (1 to 6 micrometer) astronomical spectroscopy using a Connes-type Fourier spectrometer at the coude focus of the 3 m IRTF on Mauna Kea, Hawaii. At the present time the equipment is in the final stages of preparation for its removal from JPL and shipment to Hawaii. Test observations will be made during the remainder of the current FY-80 in preparation for a full-scale resumption of activity in FY-81.

W81-70527

196-41-73

Jet Propulsion Laboratory Pasadena Calif

PLANETARY INFRARED IMAGING

Richard J Terrile 213-354-6158

The objective of this program is to provide high spatial resolution ground-based infrared and visible images and spectra of the Jupiter and Saturn systems. These data directly support instrumentation on the Voyager missions to Jupiter and Saturn and the proposed Galileo mission to Jupiter. Jupiter will be observed in the 5 micrometer window into the deep atmosphere as a continuation of a very successful program to monitor Jovian weather patterns throughout the Voyager post-encounter period. Saturn will be observed at various infrared wavelengths in order to determine if atmospheric features seen from the ground can be correlated with those observed by Voyager instruments. The suitability and philosophy of targeting the Voyager 2 Imaging Science and Infrared Interferometer Spectrometer (IRIS) experiment will also be determined. Imaging data collected with a CCD coronagraph at 8900 \AA and scan data in the infrared at 2.2 micrometer will allow targeting Voyager observations of Saturn's E-ring and provide ground-based information on Jupiter's newly discovered ring and satellite 1979 J1. Observations will be made with an existing infrared imaging system at the Hale 5 meter telescope at 1.5, 8-14 and 20 micrometer and scans will be acquired at the 3-meter NASA-IRTF at Mauna Kea Observatory. The CCD images will be acquired from the Palomar 5-meter and 1.5-meter telescopes using an existing camera and data analysis facility at Caltech. A Connes-type Fourier spectrometer is also expected to be operational at Mauna Kea Observatory and will be used to provide high spectral and moderate spatial resolution data of Jupiter, Saturn and Titan in the infrared. Simultaneous infrared imaging will also be attempted during spectroscopy runs.

W81-70528

196-41-78

Jet Propulsion Laboratory Pasadena Calif

EARTH BASED SOLAR SYSTEM OBSERVATIONS

Torrence V Johnson 213-354-7427

The work is aimed at investigating lunar, asteroidal and planetary physical and chemical properties using a variety of ground-based advanced techniques. One task utilizes the Silicon Imaging Photometer System (SIPS) to acquire multispectral data of various lunar regions. The basic objective is to correlate such spectral data with orbital and other ground-based data sets both as part of the La Jolla Consortium and as part of the PSI Basaltic Volcanism Project. It also provides for infrared imaging capability involving simultaneous 5600 \AA /2.2 micrometers imaging of the lunar near side surface with approximately 10

resolution together with imaging of particular locations at other IR wavelengths. The near infrared region is used since there are diagnostic reflectance features present to distinguish among rocks, immature soils and mature soils. Another task is the acquisition and processing of intercontinental delta VLBI observation between lunar ALSEP transmitters and extragalactic radio sources (ERS). The ALSEP/Quasar observations employ a three antenna technique in which the differential phase is obtained with sufficient signal to noise ratio for processing at the Caltech/JPL correlator. The objectives are to tie the lunar orbit to the ERS reference frame to test gravitational theories and to measure various lunar bulk physical properties. The development of this technique is also important for eventually tying the planets to the ERS reference frame.

W81-70529 **196-41-80**
 National Aeronautics and Space Administration Washington
 D C
GROUND-BASED OPTICAL PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The object of this research is to increase our knowledge of the planets, their satellites, asteroids and comets through the use of astronomical observations made with telescopes and other optical instruments located at ground based observatories. The observations will be made throughout the visible and infrared portions of the spectrum. Reduction, interpretation, analysis and publication of the data thus obtained are included as part of the objective. The interest, experience and facilities of scientists outside of NASA will be utilized to obtain data needed to support and supplement the planetary flight program. The program included under this RTOP covers observational studies of the planets, their satellites, asteroids and comets in the optical and infrared portions of the spectrum made from ground based observatories. The results of these studies are published in the open literature. The planetary science expertise and observational facilities required for this program are in general not available within the NASA centers.

W81-70530 **196-41-81**
 National Aeronautics and Space Administration Washington
 D C
ASTRONOMICAL OPTICAL INSTRUMENT DEVELOPMENT

William E Brunk 202-755-3660

The object of this research is to design, develop and construct auxiliary instrumentation to be used for ground based astronomical observations. The auxiliary instrumentation includes such items as cameras, photometers, spectrometers and interferometers. The scientific return that can be obtained under RTOP 196-41-80 is limited by the instrumentation available to the investigators. The actual level of scientific return possible from ground based observations in the optical and infrared could be much higher if additional instrumentation is developed under this task when the magnitude of the development is too great to be considered as part of the research task. Upon completion these instruments are to be used for research programs under RTOP 196-41-80.

W81-70531 **196-41-84**
 National Aeronautics and Space Administration Washington
 D C
LABORATORY SUPPORTING STUDIES (ASTRONOMY)

William E Brunk 202-755-3660

The object of this research is to obtain laboratory data required for the analysis and interpretation of planetary observations made from the vicinity of the Earth. The data obtained will be of two types: first, detailed study of gases and other materials known to exist on a planet; and second, study of the properties of many possible materials to try to explain unidentified features detected in planetary observations. The data obtained under this program will be published as well as being used directly in the interpretation of new observations. Principal investigators on tasks under RTOP 196-41-80 frequently find that there is insufficient laboratory data on the spectra of the molecular constituents they are observing. Needed are data for specific molecules at conditions and wavelengths not normally encountered in laboratory studies. It is therefore necessary to obtain the needed data using

specialized very long path absorption cells at a range of temperatures and pressures.

W81-70532 **196-41-85**
 National Aeronautics and Space Administration Washington
 D C
GROUND-BASED RADIO AND RADAR PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The object of this research is to determine planetary properties by observations from ground based observatories at radio wavelengths. Both passive (radio) and active (radar) observations will be performed. The program will include the reduction, analysis and interpretation of the observations. The interest, experience and facilities of scientists outside of NASA will be utilized to obtain data needed to support and supplement the planetary flight program. The program included under this RTOP covers observational and the associated theoretical studies of the planets, their satellites and other members of the solar system in the radio portion of the spectrum made from ground based observatories. Both passive radio astronomy and active radar astronomy observing techniques are included under this RTOP. The results of these research programs are published in the open literature. The planetary science expertise and observational facilities used in this program complement those available within the NASA centers and the Jet Propulsion Laboratory.

W81-70533 **196-41-85**
 National Aeronautics and Space Administration Washington
 D C
THEORETICAL PLANETARY ASTRONOMY

William E Brunk 202-755-3660

The object of this research is to provide theoretical support for the planetary astronomy program by predicting what data should be observed and by explaining the observational results both predicted and unexpected. The program also involves the integration of observational and laboratory results from many sources to provide an explanation of planetary phenomena. Thus this program provides an important link between the observational and laboratory programs and an understanding of the planets. Based on prior knowledge of the planets and existing physical laws, programs are undertaken to predict the observational data on the planets. As an example, theoretical atmospheric spectra are generated using assumed knowledge of the planetary atmospheric constituents, the spectral effects produced by a scattering atmosphere containing aerosols, and the dispersion of the observable spectra. Comparison of the observed spectra with the theoretically calculated spectra tests the assumptions used in the theoretical calculations.

Life Sciences SR&T

W81-70534 **199-10-10**
 Lyndon B Johnson Space Center Houston Tex
OPERATIONAL LABORATORY SUPPORT

W H Shumate 713-483-4461

The objective of the Operational Laboratories Support is to provide medical operations support by the Johnson Space Center (JSC), Ames Research Center (ARC) and Kennedy Space Center (KSC) to approved Agency programs. The medical operations support provided includes the conduct of studies to investigate countermeasures to physiological changes which occur when man is exposed to the space flight environment; clinical laboratory support of astronaut health programs; pre- and postflight testing of astronauts and operational tests and studies of the spacecraft environment; life support equipment, habitability systems and medical procedures and support equipment. The approach utilized to accomplish this objective is to maintain discipline oriented laboratories in each of the physiological problem areas covered by the Life Sciences SR&T RTOP Program. The funds will be provided for laboratory staff, equipment, supplies and data management support to accomplish the operational medicine goals and objectives of the Agency.

OFFICE OF SPACE SCIENCE

W81-70535 199-10-20
Lyndon B Johnson Space Center Houston Tex
MEDICAL SELECTION CRITERIA (MEDICAL EVALUATION AND DEVELOPMENT OF STANDARDS FOR SPACE CREW SELECTION)
S L Pool 713-483-4461

The objective of the research covered by this RTOP is to conduct longitudinal retrospective and prospective studies of the medical data on individuals who have flown in space and some cohorts who have not. The studies covered involve individuals in a closed population in an attempt to relate characteristics of the individual to the absence of or the development of disease conditions. The epidemiologic study of diseases that may not be recognized clinically for several years is often very difficult. However, as other studies such as the Framingham study have demonstrated, it is possible to isolate certain responsible host and environmental factors by means of well organized epidemiologic surveys which may span several decades in time. A vast amount of clinical data was collected on individuals who have flown in space. This is particularly true of pre- and post-flight phases of those missions; however, some data was collected in space flight. This data was obtained as a result of both operational requirements as well as experimental studies conducted during space flight. The necessity for further understanding the interaction between man and his environment in space is responsible for continuous generation of a variety of different types of medical data which will be collected during the shuttle flights.

W81-70536 199-10-30
Lyndon B Johnson Space Center Houston Tex
CREW HEALTH MAINTENANCE
C F Sawin 713-483-4264

Maintenance of crew health has always been the primary objective of medical treatment associated with the manned space flight program. Early portions of the program were empirical in nature. Man was exposed to the space environment for increasing durations with extensive postflight testing to quantitate physiological changes. No specific evidence exists to support early concerns that there would be pathological changes associated with exposure to the environment of space. Instead, a fairly consistent pattern of adaptation to microgravity has evolved with the successful completion of the Mercury, Gemini, and Apollo and Skylab Programs. Certain areas of physiological change lend themselves to intensive study during the relatively short duration (7-10 days) of early shuttle flights. Other known changes (e.g., bone demineralization) can best be studied on long duration missions. One important area to be investigated is the requirement for inflight crew exercise. This effort is extremely important because crew time is a limited mission resource. Past experience shows that crewmen desire to exercise 1.5 hours daily to maintain their fitness. Some quantitative losses in leg strength occurred even with that amount of inflight exercise. One goal is to provide a logical, defensible reduction in flight crew exercise requirements. This must be accomplished without impairing crew performance.

W81-70537 199-10-41
Lyndon B Johnson Space Center Houston Tex
SYSTEMS HABITABILITY VERIFICATION
James M Waligora 713-483-5457

A large portion of biomedical research conducted as part of the Space Program has to do with the effect of space specific environments on man and other organisms. What may be less obvious as a potential problem is that the environment that man is exposed to in space is almost entirely a man-made environment. Many environmental factors that are relatively constant in the Earth's atmosphere such as O₂ and CO₂ concentration and pressure must be carefully controlled by environmental control systems in the space vehicle. Acceptable control ranges and emergency ranges for environmental factors must be specified and it must be verified that the spacecraft can maintain the environment within these specifications. The specifications must provide for the safety and well-being of the crew and must also provide an environment stable enough to allow biomedical study of the space-unique environmental factors. In arriving at specifications for these environmental factors

considerations must be given to the difficulty involved in controlling a given environmental factor within a given control range and the implications in terms of cost, weight and reliability. Defining these limits and verification that the limits are met in the spacecraft will require research in specific areas.

W81-70538 199-20-00
Lyndon B Johnson Space Center Houston Tex
SPACE MOTION SICKNESS
J L Homick 713-483-5457

The overall objective of this research program is to produce the information required to solve the problems of space motion sickness and neurosensory adaptation to the weightless space flight environment. A broad based program of interrelated studies will be undertaken to delineate the etiology of the space motion sickness syndrome and to develop effective measures for its prediction, prevention and treatment.

W81-70539 199-20-50
Lyndon B Johnson Space Center Houston Tex
BLOOD ALTERATIONS (INFLUENCE OF SPACE FLIGHT ON THE BLOOD-FORMING TISSUES)
C S Leach 713-483-4086
(199-20-60)

The most significant effect of the space flight environment observed relative to the blood and blood-forming tissues in man has been a consistent reduction in the circulating red blood cell mass during the flight interval. The variations in the magnitude of the loss in individual crewmen and the complicated postflight recovery kinetics suggest a complex relationship between the red cell mass loss and the duration of the exposure to weightlessness. This anemia of space flight was frequently accompanied by a reduction in plasma volume, apparently occurring early in the mission and sustained throughout the flight. Other more subtle effects were observed with respect to the function and structure of red blood cells and of lymphocytes and in the concentration of some plasma proteins. The major emphasis of this research program will be to address questions relative to the regulation of blood volume during space flight and the causes of its apparent failure. The primary objectives will be to elucidate the mechanisms and etiology of the alterations in red cell mass and plasma volume and to determine the significance of these changes in limiting man's (both astronaut and nonastronaut) participation in space flight activities associated with the shuttle Program.

W81-70540 199-20-60
Lyndon B Johnson Space Center Houston Tex
FLUID AND ELECTROLYTE CHANGE
Carolyn S Leach 713-483-4086

Body fluid compartment shift occurs in early exposure to weightlessness. These changes are complicated by losses in electrolytes (sodium, potassium, calcium, phosphorus, magnesium and chloride) occurring at a slower rate over mission duration which further influence fluid distribution. Hormonal responses are elicited to counteract these changes. The purpose of this program will be to study these changes and their effect on man's (astronaut and non-astronaut) ability to function in space. Results of the investigations will provide an understanding of the physiological and biochemical effects of weightlessness and rationale for nutritional and/or other countermeasures for use in future space flight missions. The information gained from exposure of man to weightless flight for periods approaching 3 months has shown that fluid and electrolyte metabolism has been altered in all crewmen studied. It is apparent that the changes experienced are multiphasic and are caused not only by the weightless environment but also by conditions related to the preparations for flight, the activity during flight and the recovery procedures. The overall objective of this research program is the elucidation and definition of biochemical agents and physical factors operative in the processes associated with fluid and electrolyte metabolism in the space flight environment.

W81-70541

Lyndon B Johnson Space Center Houston Tex
RADIATION EFFECTS AND PROTECTION

C M Barnes 713-483-5281

199-20-70

This RTOP presents the initial stage of a restructured long-term program of research on the space ionizing radiation environment and its consequences for manned space operations. While currently available information is sufficient for early shuttle missions, research priorities of the attached program are based on the assumption that NASA's long-term plans will involve man in geostationary orbit before the year 2000. Based on knowledge obtained from previous research under this RTOP, exposure to ionizing radiation may be the limiting factor in both mission duration and total career for the crew. Furthermore, shielding considerations especially for protection from solar flares may influence significantly the detailed design and total mass of a spacecraft. To provide timely solutions to these problems in the mission planning stage, the underlying research must be initiated now. A plan is presented for research in the specific areas of radiobiology, radiation environment and radiation protection.

W81-70542

199-50-94

Jet Propulsion Laboratory Pasadena Calif
PLANETARY PROTECTION PROGRAM

Maryin Christensen 213-354-9627

The present Planetary Protection (PP) Program is based on existing international, national and NASA agreements. For years the primary thrust of the program has concentrated on the exploration of Mars. Now that the Viking mission has concluded, the program guidelines need to be re-evaluated by the NASA, the National Academy of Sciences Space Science Board and others including JPL PP Office. This evaluation will focus on the validity of the present approach, particularly in view of recent planetary data. This information must be set in the perspective of the proposed NASA mission model, inclusive of missions within the next ten years. Where the data are supportive, consideration will be given to modification or deletion of present policies. Since the program basis is established in treaty obligations (in which NASA played a key role in developing) care must be taken in revising these obligations within an appropriate framework. Additionally, some effort will be directed toward NASA/OSS's role in the protection of life science experimentation. Millions of dollars are spent in instrument development; however, NASA has no focal point to assure itself that contamination will not degrade or prevent the instrument from making planned observations and measurements. As a final programmatic element, consideration will be given to missions on the horizon for which PP requirements are unclear or for which the requirements could pose significant problems in authorization of the program. Sample return missions clearly fall into this category. Items identified as requiring a long lead time for resolution should be addressed at a low but consistent level.

W81-70543

199-60-60

Jet Propulsion Laboratory Pasadena Calif
MAN-MACHINE SYSTEMS

A K Bejczy 213-354-4568
 (199-60-80 506-54-85 906-75-27)

The general objective is to develop basic understanding for critical man-machine system interface elements from the viewpoint of human capabilities and behavior, taking into consideration man's anticipated role in working with machines operated in space. In the terminology of modern information/control machines, man is essentially a single channel processor, although he is equipped with multiple input/output capabilities. There is a need to quantitatively understand man's present and future functional role in the expanding world of modern machines and accommodate man's capabilities accordingly. The near-term objective is twofold: (1) expand man's capabilities to communicate with machines and (2) study and develop general techniques suitable to evaluate man's perceptive/cognitive performance in interacting with machines on the symbolic level. The general approach is to study and evaluate the utility of modern techniques in (1) machine recognition of human speech and (2) machine recognition of human perceptive/cognitive responses to symbolically presented tasks under varying workload conditions. The specific FY-81 goal

is twofold: (1) to experimentally study machine recognition of connected speech for man-machine command/control communication and (2) to conduct experimental evaluation of modern psychophysiological techniques in detecting multiple perceptive/cognitive responses from event-related potential wave measurements on the human scalp. The first task will utilize capabilities existing at the JPL teleoperator laboratory in machine recognition of discrete words and will also utilize a speech recognition frame developed at Carnegie-Mellon University and evaluated at JPL previously. The second task is a logical continuation of work performed in FY-80 jointly with the University of Illinois to detect single perceptive/cognitive responses from event-related potential measurements. It is planned to perform the multiple response measurements jointly with UCLA in FY-81.

W81-70544

199-60-71

Lyndon B Johnson Space Center Houston Tex

MAN-MACHINE ENGINEERING REQUIREMENTS FOR DATA AND FUNCTIONAL INTERFACES

J L Lewis 713-483-4966

The objectives of this research are to move toward quantification of man-machine engineering data both on the ground and in flight to continue to pursue state-of-the-art technology and to advance that technology for the purpose of creating more effective and efficient man-machine interfaces for manned spacecraft and to improve techniques of man-machine engineering design so that innovative steps may be taken toward creating better crew interfaces in future vehicles. The approach will be to implement a series of continuing tasks to identify and implement workable instrumentation packages for acquiring quantitative man-machine engineering data in one-g simulated zero-g and actual zero-g to continue those efforts currently defined that lead toward definitive design requirements for use as inputs to the Design Performance Lab and to pursue feasibility studies of promising new crew interface items.

W81-70545

199-60-80

Jet Propulsion Laboratory Pasadena Calif
ADVANCED TELEOPERATION STUDIES

A K Bejczy 213-354-4568
 (199-60-60 506-54-85 906-75-27)

The general objective is to develop basic understanding of remotely manned systems so that space missions requiring the use of such systems can be planned and implemented with the required reliability, performance and economy. The specific objective is to develop conceptual designs and breadboards in order to study, determine and evaluate the complementary roles of man and machine in teleoperated systems. The specific FY-81 objectives are (1) to determine and evaluate the anthropometric and anthropomorphic parameters for kinesthetic coupling of man to a remote manipulator; (2) to determine and evaluate the ramifications of symbolic versus analog or combined symbolic and analog communication between man and remote manipulator; and (3) to determine and evaluate man's perceptive/cognitive command/control effectiveness for varying presentations of remote control task scenarios, moving versus static, absolute versus relative, integrated versus compartmentalized, etc. The experimental studies will utilize laboratory breadboard elements developed previously at JPL. The results will be documented in scientific papers and reports. The approach is to conduct experimental studies on various functions of teleoperated systems. The experimental studies will give insight into the functions to be performed by man or machine or both for remote explorations or operations. Function allocation will be utilized between man and machine for various operational constraints, including time delays in order to study system performance and identify needs for new subsystem developments. New system or subsystem concepts will be developed and breadboarded when appropriate for feasibility and performance evaluation studies.

W81-70546

199-70-31

Lyndon B Johnson Space Center Houston Tex

GLOBAL TERRESTRIAL ECOLOGY

D S Nachtwey 713-482-5281
 (199-20-71)

The objective to this program was to investigate and define

OFFICE OF SPACE SCIENCE

the extent of the impact on human health and the biosphere that may be caused by increased ultraviolet radiation resulting from stratospheric ozone layer reduction by space transportation systems (STS) operations and other potential NASA activities. This activity is being phased out during FY-80. A new additional objective is to examine the feasibility of establishing a program in global ecology. This RTOP will be rewritten at HQs during FY-80 to reflect this new direction.

W81-70547 **199-90-71**

Lyndon B Johnson Space Center Houston Tex

INTERDISCIPLINARY RESEARCH

Lawrence F Dietlein 713-483-6291

The Life Sciences Directorate at Johnson Space Center is responsible for the development of a comprehensive biomedical research program in support of manned space flight. This broad multidiscipline mandate to acquire new knowledge is directed toward the acquisition of definite data regarding the effects of the space environment on life systems in order to define the critical physiological and psychological variables which must be integrated into the overall considerations of spacecraft designers and mission planners. The objective of the interdisciplinary research RTOP is to provide flexibility in the accomplishment of this goal.

Solar Terrestrial Spacelab Payload Definition

W81-70548 **356-36-01**

Marshall Space Flight Center Huntsville Ala

SPACE PLASMA PHYSICS

W C Snoddy 205-453-3430

The objective of this RTOP is to address and define space plasma investigations through several diverse approaches. The experiments and studies are as follows: (1) by active injection and observation of chemical tracers into the Earth-Space Environment; (2) to provide scientific and engineering support to the Active Experiments Working Group; and (3) by definition of investigations and instruments for the early Tethered Satellite System flights (2 Tasks). This RTOP also supports the development and dissemination of research results and information on the Solar Terrestrial Environment.

W81-70549 **356-38-01**

Marshall Space Flight Center Huntsville Ala

ADVANCED MISSION STUDY - SOLAR X-RAY PINHOLE SATELLITE AND LONG FOCAL LENGTH CORONAGRAPH

J R Dabbs 205-453-3430

Hard X-ray imaging (10 - 100 keV) from solar flares will contribute not only to our knowledge of the sources directly associated with the chromospheric manifestations of flares but will also help us to explore the corona. A solution to the problem of achieving significantly better angular resolution for hard X-rays lies in the pinhole experiment concept. An equally important use of the pinhole satellite will be its application as an external occulter for coronagraph observations of the solar corona. Previous feasibility studies have investigated alternative stabilization techniques and preliminary optical systems design for a long focal length coronagraph which will be flown on Spacelab mission utilizing a boom deployed occulting and aperture mask. Separations on the order of 50 meters could afford sub arc second X-ray imaging of the Sun and also provide highly effective occultation experiments in both visible and UV regions. The Spacelab facility is expected to mature into longer focal length facilities either adjunct to the space platform or as separate free flyers.

W81-70550 **356-78-01**

Marshall Space Flight Center Huntsville Ala

SPACELAB SCIENCE PAYLOADS DEFINITION ATD - GENERAL

W C Snoddy 205-453-3430

The purposes of this RTOP are to conduct studies, perform assessments and develop systems to enhance Solar Terrestrial Investigations thru the use of Spacelab and its evolution to space platforms. These studies will be directed towards the scheduling and grouping of candidate experiments, assessment of programmatic and physical accommodation requirements for science instruments, operations planning, definition of data systems and

other necessary support systems for science instruments on Spacelab and evolving platforms will be performed.

Astrophysics Spacelab Science Payload Definition

W81-70551

358-41-06

Ames Research Center Moffett Field Calif

DEVELOPMENT OF SHUTTLE INFRARED TELESCOPE FACILITY (SIRTF)

L S Young 415-965-6546

The objective of this RTOP is to develop the shuttle infrared telescope facility (SIRTF) to develop scientific instruments for the SIRTF focal plane and to operate SIRTF as a facility on Spacelab. SIRTF will provide a flyable facility that will accept multiple focal plane instruments for use by infrared astronomers during the shuttle era. The conceptual design of SIRTF has been the subject of several studies and the shuttle/Spacelab accommodations and SIRTF flight operations have also been studied. Scientific instrument concepts and their accommodation in SIRTF have been studied by teams of astronomers. The conceptual studies have identified the key technologies for SIRTF and for future instruments beyond the current state of the art and technology development in those areas is being conducted. The conceptual studies were sufficiently detailed to allow cost estimates for SIRTF to be made. The approach for this RTOP is to (1) complete development of the technology needed for the design and development of SIRTF for the first two missions and (2) to coordinate the results of previous studies and the technology development and to increase the depth of the design definition by performing a phase B study.

W81-70552

358-78-01

Marshall Space Flight Center Huntsville Ala

SPACELAB SCIENCE PAYLOAD DEFINITIONS ATD - GENERAL

W C Snoddy 205-453-3430

In recent months the Astrophysics Division of the Office of Space Sciences has been developing the needs and requirements for the evolution of Spacelab experiment and payload to low-Earth orbit Science and Applications Space Platforms (SASP). Based on input from potential users and NASA planning activities, preliminary mission models for potential space platform missions and preliminary space platform concepts were developed to determine if platforms were technically feasible. Consequently a Science and Applications Space Platform Conceptual Design Study has been initiated by NASA along with a redevelopment of the user needs and requirements. The objectives of this RTOP are to firmly establish the astrophysics accommodation requirements for a space platform system and to determine the advantages and/or disadvantages to astrophysics programs. To accomplish these objectives, payload accommodations assessment analysis of the astrophysics requirements will be carried out and operational scenarios will be developed.

W81-70553

358-78-60

Jet Propulsion Laboratory Pasadena Calif

STUDY OF LARGE DEPLOYABLE ANTENNAS FOR ASTRONOMY APPLICATIONS

Paul N Swanson 213-354-3273

(540-01-15)

The objective of this RTOP is to develop a conceptual design for a large (10 to 30 m diameter) deployable parabolic reflector for use in submillimeter and far-infrared astronomy. Such a telescope is intended to provide high angular resolution and large collecting area in a wavelength range in which ground-based observations are prevented or greatly impeded by atmospheric absorption and emission. It will complement in capability ground-based telescopes for adjacent wavelength ranges (millimeter/near infrared) now operating or planned for the next decade. While astronomy provides the prime motivation for this RTOP, other applications may exist in space communications and remote sensing. The fact that this program is based strongly on technology developed with DARPA funding is evidence of other potential applications. The approach in cooperation with the Ames Research Lab will be to use the results of the FY-80 study (which included a subcontract with Lockheed) to develop one (or a few) reflector concept(s) which will incorporate the most promising technologies relevant to mechanical configuration.

surface materials active control and surface measurement Various trade-offs such as diameter versus minimum wavelength both functions of costs will have to be made A science workshop will be convened which will address these trade-offs in the light of scientific priorities A recommended conceptual design will then be developed which will maximize the scientific return with the bounds of reasonable cost and high-confidence technology

Solar Terrestrial Data Analysis

W81-70554 385-36-01

Goddard Space Flight Center Greenbelt Md

ATMOSPHERE-IONOSPHERE-MAGNETOSPHERE INTERACTIONS

R E Harte 301-344-8234

The basic objective is to study the observed properties of the inner magnetosphere ionosphere mesosphere and thermosphere to identify and understand the physical and chemical processes operating in these regimes emphasizing how they interact This is achieved by processing analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated permitting the study of long-term phenomena comparison of data with new theories and models correlative studies of data obtained from various satellites and ground based observatories and the deposition of additional data in the National Space Science Data Center The essential data to be used in this investigation include electron densities and temperatures ion and neutral composition neutral winds ion temperatures and drifts electric fields magnetic fields electromagnetic radiation and energetic particles of magnetospheric and ionospheric origin These data are used to determine the various interrelated chemical compositional dynamical and energetic states of the inner magnetosphere ionosphere thermosphere and mesosphere and the transport and deposition of mass momentum and energy in and between these physical regions These basic properties and processes are then used to analyze specific geophysical phenomena such as electric field induced ion drifts in the ionosphere and inner magnetosphere chemistry and dynamics of mid and high latitude troughs auroral substorms ionospheric storms Joule heating PCA events tidal and gravity waves depletion and filling of plasmasphere ionospheric plasma resonances equatorial bubble formation SAR Arcs ring current decay etc

W81-70555 385-36-01

Marshall Space Flight Center Huntsville Ala

MAGNETOSPHERIC DATA ANALYSIS

C R Chappell 205-453-3036
(170-36-55)

The objective is an adequate understanding of the dynamics of low-energy plasma in the earth's magnetosphere through (1) analysis of the light ion mass spectrometer data from the NASA/DOD SCATHA Satellite (2) laboratory simulation of plasma flow around different objects (3) analysis of data on plasmasphere temperature and dynamics (4) analysis of data and development of models relating to the effects of spacecraft plasma sheaths upon low-energy charged particle data and (5) development of multispacecraft merged data sets and advanced display techniques

W81-70556 385-36-01

Ames Research Center Moffett Field Calif

PIONEER 6-11 PLASMA DATA ANALYSIS

J D Mihalov 415-965-5516
(170-36-55)

This research provides for analysis of solar wind plasma data from Pioneers 6 through 11 The solar wind proton and helium parameters including proton temperature anisotropy are obtained from the plasma analyzer data using least squares fitting computer programs Gradients of solar wind parameters with heliocentric distance are determined using data from Pioneers 10 and 11 Solar wind plasma time variations are also correlated with scientific data from other spacecraft and with Earth based observations to study the steady and dynamic characteristics of the solar plasma flow and the solar wind-geomagnetic field interaction Data analysis and averaging programs are maintained Data is supplied in various forms to co-investigators

W81-70557

385-36-02

Goddard Space Flight Center Greenbelt Md

DATA ANALYSIS - SPACE PLASMA PHYSICS

J K Alexander 301-344-5461

The basic objective is to study the observed properties of the interplanetary medium and the magnetosphere and to identify and understand the physical processes operating in these regimes including how they interact This is achieved by processing analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated permitting the study of long-term phenomena comparison of data with new theories and models correlative studies of data obtained from various satellites and ground-based observatories and the deposition of additional data in the NSSDC The essential data to be used in this investigation include magnetic fields plasma waves energetic particles plasma and kilometric radiation These data are used to determine the various dynamical and energetic states of the interplanetary medium and the magnetosphere and the transport and deposition of momentum and energy within and between these physical regions These basic properties and processes are then used in the study of specific geophysical phenomena such as interplanetary current sheets energetic particle acceleration and magnetic fields and plasma in the magnetosheath and the magnetotail Basic theory complementary effort is carried out in the areas of kinetic plasma physics and the motion of charged particles in electromagnetic fields

W81-70558

385-36-04

Goddard Space Flight Center Greenbelt Md

ENERGETIC PARTICLES AND PLASMAS IN THE MAGNETOSPHERES OF JUPITER AND SATURN

T G Northrop 301-344-7736

The objective of this study is to gain an understanding of the sources sinks and dynamics of energetic (> 0.1 MeV) ions and electrons in the magnetospheres of Jupiter and Saturn This work will apply plasma theory and the theory of charged particle motion to data taken by Pioneers 10 and 11 and by the Voyagers Included in the dynamics will be a study of the observed effects of moons in the fluxes and deduction of diffusion coefficients from these observations

W81-70559

385-38-01

Goddard Space Flight Center Greenbelt Md

SOLAR PHYSICS DATA ANALYSIS AND OPERATIONS

Robert D Chapman 301-344-5101

The objectives of this research are (1) to process analyze and interpret experiment data from flight projects and to continue this work after the immediate fundings from project offices have terminated (2) to publish in scientific literature detailed studies of phenomena gathered over protracted periods of time which reveal long-term features and correlation effects not evident during the prime data analysis (3) to engage in multidisciplinary studies comparing experiment data from other satellites and/or ground based laboratories in order to investigate in fine detail fine structure long term and secular effects and (4) to provide additional reduced analyzed data for archive in the National Space Science Data Center During the prime analysis period many theoretical ideas about the observed phenomena are developed and the correlation of the data with other ground-based or satellite data is suggested In addition to study a given phenomena over an adequate range of the important independent variables such as solar region wavelength solar cycle etc it is necessary to process large quantities of data covering extended periods of time Thus additional data will be processed and analyzed multieperiment studies will be made and various proposed models or theories will be critically tested by use of this data Ground-based spectroheliograph measurements will be correlated with satellite observations

W81-70560

385-38-01

Marshall Space Flight Center Huntsville Ala

DATA ANALYSIS, SOLAR PHYSICS

M J Hagyard 205-453-0118
(170-38-52)

The objective of this program is to analyze the solar vector

OFFICE OF SPACE SCIENCE

magnetic field data obtained from observations with the MSFC *vector magnetograph specific objective is to infer the maximum information provided by these data on electric currents flowing through and above the solar photosphere* The approach is to derive theoretical formulations which extract that part of the observed magnetic field which gives rise to currents and to compare predicted theoretical field lines with actual observations

Astrophysics Data Analysis

W81-70561 389-41-01

Goddard Space Flight Center Greenbelt Md
DATA ANALYSIS ASTRONOMY
J M Mead 301-344-8543
(188-41-51 188-41-55)

The objective of this research is to develop tools and techniques which will facilitate and improve the reduction analysis and understanding of astronomical data primarily through the application of computers for managing large blocks of observational information obtained at all wavelengths for stars, galaxies and other extended objects. This objective is being carried out through the development of (1) an Interactive Astronomical Data Analysis Facility which is designed and operated to provide astronomers with the display, enhancement and analysis tools that they need to interpret their digitized images and spectra and (2) a Computerized Astronomical Data Retrieval System which provides data searches, digital plots and bibliographical information for specified catalogue ID numbers, positions and other parameters at ultraviolet, optical, infrared and millimeter wavelengths. Other tasks in this RTOP include analyses of spectrophotometric observations made by space-borne astronomical payloads in order to study mass flow from stars, interactions in close binaries, circumstellar and interstellar matter and stellar chromospheres and the preparation of two books summarizing and evaluating observational and theoretical knowledge currently available about the physical state of O and B stars.

W81-70562 389-46-01

Goddard Space Flight Center Greenbelt Md
HIGH ENERGY ASTROPHYSICS DATA ANALYSIS
F B McDonald 301-344-8801

The objectives of this research are (1) to process, analyze and interpret galactic, interplanetary, Jovian and solar cosmic ray data from space flight experiments after the immediate funding project offices have ceased and for detailed studies of these phenomena involving multi-satellite data sets (2) To engage in multidisciplinary studies comparing experiment data from other satellites, deep space missions and manned missions such as Skylab, as well as using ground-based observations to study in detail a wide range of high energy astrophysics phenomena (3) To publish these results in the scientific literature (4) To make the data available to the National Space Science Data Center

W81-70563 389-46-03

Goddard Space Flight Center Greenbelt Md
THEORETICAL HIGH ENERGY ASTROPHYSICS
R Ramaty 301-344-8715

The objectives of this research are (1) To conduct fundamental theoretical research in high energy astrophysics with particular emphasis on studies related to gamma ray, X-ray and cosmic ray astrophysics. This program is in the forefront of theoretical research in these areas of astronomy and is pertinent to the overall observational and experimental program of the Laboratory for High Energy Astrophysics (2) To publish in the scientific literature and to present at professional meetings the significant results of such research (3) To collaborate with and support theoretical research of graduate students, research associates and occasionally senior faculty members on leave from academic institutions (4) To provide theoretical support in planning space experiments in high energy astrophysics and to create the theoretical framework for the interpretation of the results from such experiments. The group in the Laboratory for High Energy Astrophysics consists of three senior theoretical astrophysicists

(R Ramaty, F C Jones, F W Stecker and four research associates (A Harding, D Kazanas, D Leiter and P Meszaros)

W81-70564

389-46-04

Goddard Space Flight Center Greenbelt Md
X-RAY ASTRONOMY DATA ANALYSIS
J H Swank 301-344-6188

Information about sources has grown steadily over the past few years with the discovery of new temporal and spectral phenomena in known sources, the resolution of new sources and the identification of many with optical, infrared or radio objects. The data bases of our experiments contain further as yet unexamined information about these sources. The data from Ariel 5, OSO-8, HEAO-1 and HEAO-2 will span over 5 years and offer complementary information on the X-ray sky, including time variability of sources on time scales of milliseconds to years and spectra from 5 keV to 200 keV in many cases with simultaneous coverage by other groups down to 2 keV and up to 10 MeV. We propose to study using data from the All Sky Monitor on Ariel 5, the GSFC Cosmic X-Ray Spectroscopy Experiment on OSO-8, the HEAO A2 experiment and the Solid State Spectrometer on the Einstein Observatory, sources showing yet unstudied variability sources whose spectra have not been understandable with simple models. Spectral-temporal correlations best studied with multiple observations and models recommended by recent theoretical work and observations in other wavelengths. These experiments also provide information on the detectors particle background which would be of use to future missions.

Astrophysics Explorer Studies

W81-70565

685-20-06

Goddard Space Flight Center Greenbelt Md
EXTREME ULTRAVIOLET EXPLORER
Samuel Willis 301-344-8566

The objective of this RTOP is to provide a detailed study of the 4 telescopes with detectors and star camera in the trapezoidal Euve configuration. The study will include the writing of detailed execution phase specifications. The study to be funded through UCB must be done in sufficient detail to assure that the follow-on experiment hardware can be procured within the allocated cost. The Euve spacecraft described in the Euve Preliminary Execution Phase Project Plan (PEPPP) will be studied in sufficient detail to assure that the spacecraft hardware can be procured within the allocated cost. The study should examine in detail all aspects of launch and retrieval. The study should also include the writing of detailed execution phase specifications.

W81-70566

685-20-08

Goddard Space Flight Center Greenbelt Md
COSMIC BACKGROUND EXPLORER (COBE)
G W Longanecker 301-344-7751

The objective of the Cosmic Background Explorer (COBE) is to further the knowledge of science in the area of astrophysics, more specifically observational cosmology. COBE will make a definitive exploration and study of the diffuse radiation of the universe between the wavelengths of 1 micron and 13 mm. This band includes the 3K cosmic background radiation thought to be the residual radiation from the Hot Big Bang which started the present expansion of the universe. It also includes the infrared region from 1 micron to 300 microns where the diffuse radiation of the universe has yet to be detected. This infrared band may include a large portion of the dominant part of the energy content of the universe, including the radiation from primeval galaxies. A 1 year long mission is envisioned during which time the entire celestial sphere will be observed at least twice. In support of these objectives, GSFC has established a COBE Systems Definition Phase Project. It is responsible for detailed project definition. They will start with the Preliminary Execution Phase Project Plan as a primary product and will produce an Execution Phase Project Plan.

W81-70567

685-20-11

Goddard Space Flight Center Greenbelt Md
X-RAY TIMING EXPLORER (XTE)
William Hubbard 301-344-7697

The objective of this RTOP is to develop the technical and scientific basis for an X-ray Timing Mission to be proposed for

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

flight in FY-86 or FY-87. The Explorer class mission will observe X-ray sources with instruments having high temporal resolution to complement X-ray data from HEAO and the planned Advanced X-ray Astrophysics Facility programs. A cooperative program with the Netherlands Agency for Aerospace Programs (NIVR) is under serious consideration. The approach will be to establish a science definition team that will provide science planning for the mission and will identify system requirements and typical instrument characteristics. A preliminary system design will be produced to demonstrate feasibility, provide a basis for cost estimating and support the Announcement of Opportunity to be issued by NASA Headquarters. The general approach to the cooperative program is for the NIVR to build the spacecraft and NASA to manage the science; however, a specific division of responsibilities will not be established before November 1980. A final decision on the cooperative venture is anticipated in early-1981 and a formal agreement 1 year later.

Sounding Rockets -- Solar Terrestrial Experiments

W81-70568 828-11-36
Goddard Space Flight Center Greenbelt Md
SONDING ROCKETS MAGNETOSPHERIC PHYSICS EXPERIMENTS
James P Heppner 301-344-8797

The objective is to perform measurements that will lead to an understanding of the interactive processes that occur between neutral gases, plasmas, energetic particles and electric fields in the atmosphere, ionosphere and near earth magnetosphere. Emphasis is placed on measurements and experiments that utilize the unique characteristics of sounding rocket trajectories and/or the low cost, quick reaction sounding rocket approach which permits program flexibility. This approach has logically been extended to include (1) piggyback experiments on the orbiting upper stage of two stage Delta vehicles, (2) experiments involving sounding rocket flights in association with simultaneous satellite measurements in selected geometrical coincidence between trajectories, (3) flight testing of new instrumentation and measurement techniques and (4) shuttle ejection of low cost rocket type payloads in the EOP (Experiment of Opportunity) mode.

W81-70569 828-11-38
Goddard Space Flight Center, Greenbelt Md
SONDING ROCKETS EXPERIMENT
Robert D Chapman 301-344-5101

The sounding rocket program provides unique capabilities to conduct a broad range of scientific investigations. The program is particularly important for the development and demonstration of the merit of new instruments for shuttle flights and of prototype instruments for satellites. Furthermore, the short lead time and program flexibility make it possible to follow up new discoveries and to study particular phenomena on the Sun and in the Earth's atmosphere. Extreme ultraviolet spectra (EUV) of the Sun are a valuable tool for determining the true physical conditions in the solar corona. Of particular interest are the determination of the flow of matter and energy from one region to another in the corona. For this purpose we need to know the coronal density, temperature, gas velocity and radiation field. The work under this task is directed toward the development and flight on rockets of instruments for determining these four physical parameters in the corona. A better determination of the characteristics of the solar corona is necessary in order to discover the paradoxical reasons why a coronal gas temperature of more than one million degrees can be maintained by energy from a region whose temperature is only five thousand degrees. These measurements are also important for determining the origin of the solar wind which may arise from regions of open magnetic field.

W81-70570 879-11-46
Goddard Space Flight Center Greenbelt Md
SONDING ROCKET EXPERIMENTS (HIGH ENERGY ASTROPHYSICS)
E A Boldt 301-344-5853

High energy astrophysics (especially X-ray astronomy) is a rapidly evolving field of research, both scientifically and technically. Our exploitation of the capabilities of short lead time planning, flexibility, accurate pointing and extremely high telemetry rates (most important) afforded by rocket-borne experiments are major factors in our success to date. A vigorous elaboration of this activity is now necessary for continuing to make timely and important contributions that complement our satellite missions and for the effective planning of advanced future missions. This involves experiments with systems incorporating newly developed spectrometers, X-ray concentrators and imaging devices.

Sounding Rockets--Astrophysics

W81-70571 879-11-41
Goddard Space Flight Center Greenbelt Md
SONDING ROCKETS EXPERIMENTS (ASTRONOMY)
T P Stecher 301-344-8718

The astronomical sounding rocket program provides a unique capability to conduct a broad range of scientific investigations. The program flexibility and short lead time make it possible to observe unusual physical phenomena for which satellite instrumentation is not available. The program flexibility makes it possible to expeditiously follow-up discoveries as well as to provide tests and calibrations of satellite instrumentation. This unique capability is exploited by obtaining one of a kind observations of those types of astronomical phenomena that do not need large amounts of repetitive data to delineate their physical processes. Many new types of observations are now possible because of recent technical advances in both attitude control and new detectors. These observations are necessary in order to understand and analyze many properties of the interstellar medium, stars, nebulae and peculiar galaxies. The present objectives are to develop payloads to obtain ultraviolet images of the weak sources now accessible as a result of improved pointing devices. Old payloads will be improved and used again and new payloads will be developed to take advantage of modern sensors and image intensifiers. The properties of galaxies and peculiar galaxies will be studied by means of their ultraviolet images. Procedures for absolute photometry of the stars and galaxies will be investigated. All instrument development will be done in such a manner that the instruments can be used on Spacelab or as Shuttle Experiments of Opportunity (EOP).

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

Supporting Research and Technology

W81-70572 310-10-23
Goddard Space Flight Center Greenbelt Md
SOFTWARE ENGINEERING TECHNOLOGY
F E McGarry 301-344-5048
(310-10-26)

The objective of this RTOP is to identify, evaluate and refine software engineering technology as applied to three disciplines of software development, management and maintenance. The software engineering technology to be studied includes software methodologies (such as design techniques, structured implementation techniques and design evaluation techniques), software tools (such as management support tools, code auditors and analyzers and automated design tools) and software support models (such as resource estimation models or reliability estimation models). The identified methodologies are intended to significantly reduce the overall life cycle costs of the software within the Mission and Data Operations area. The approach to

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

attain the stated objectives includes the establishment of a laboratory environment through which the identified areas of software technology can be investigated measured and refined under suitable conditions. The laboratory will support the research effort in the area of software development, management and maintenance. Within the laboratory environment candidate technologies will be identified appropriate measures to be used in the evaluation process will be developed a data collection scheme will be identified and the experiments will be conducted where the candidate methodologies will be applied to software development and maintenance tasks. This is a systems level RTOP supporting the areas of TDRSS Operations Mission Support Computing and Mission Operations

W81-70573 310-10-26

Goddard Space Flight Center Greenbelt Md

ATTITUDE/ORBIT SYSTEMS TECHNOLOGY

J Teles 301-344-7999
(541-01-16 310-40-39 310-20-33 310-20-37 310-20-27
310-40-26)

The objective of this RTOP is to develop evaluate and demonstrate new technology for attitude and orbit determination/prediction/analysis for both ground-based and onboard applications including algorithms techniques software and hardware. The technology developed under this RTOP supports the Space Tracking and Data System in the areas of spacecraft data acquisition TDRSS Operations Mission Support Computing and data processing. Various techniques algorithms and filters will be developed and compared for their applicability to onboard navigation using TDRSS data. Current techniques will be evaluated for trajectory modeling studies. Techniques for refining current models and formulating new models will be developed. Multispectral scanner and thematic mapper data will be added to the attitude analysis system and analyzed using various filters. A system will be developed to analyze image correction techniques. A prototype autonomous orbit determination system will be developed analyzed evaluated and refined. A prototype autonomous attitude determination system development will begin. Detailed hardware requirements and configuration plan and detailed design of the transponder modifications and Doppler extractor will be developed and an overall experiment detail design will be initiated for an autonomous navigation flight experiment

W81-70574 310-10-42

Goddard Space Flight Center Greenbelt Md

PRECISION TIME AND FREQUENCY SOURCES

Victor S Reinhardt 301-344-5946
(644-03-15)

The objectives of the RTOP are to develop improved frequency and time standards to improve existing hydrogen maser frequency standards and to develop associated time and frequency distribution and measurement systems for VLBI and near Earth and deep space tracking. Both the NR and NP masers will continue to be upgraded. Major improvements planned are an integral quartz cavity-storage bulb for the NR masers and reduction in the magnetic sensitivity of the NP maser. Work will continue on a low cost hydrogen maser. Next year the maser will be designed in detail and some of the hardware used will be procured or fabricated and tested. For hydrogen maser operational support a portable field test kit will be developed. The external bulb hydrogen maser will be operating by next year and will undergo extensive testing and evaluation. The modular frequency and time distribution and measurement system has been developed. Using this system the frequency combiner/selector and the data acquisition system will be completed and preliminary work on the remote distribution and measurement system will be begun

W81-70575 310-10-60

Jet Propulsion Laboratory Pasadena Calif

RADIO METRIC ANALYSIS. DEMONSTRATION AND INSTRUMENTATION DEVELOPMENT

C L Thornton 213-354-2244
(310-10-61 310-10-62 310-10-63 310-10-64)

The broad objective of this RTOP is development of the advanced radio metric systems employed by the Deep Space Network for spacecraft navigation and radio science. The

requirements which will be placed upon the navigation system by proposed future deep space missions are expected to be stringent. Thus, one of the major goals of this RTOP is to identify and investigate new radio metric techniques useful for navigation. Current attention is focused on development and demonstration of Very Long Baseline Interferometry (VLBI) navigation concepts. The technique having the highest potential accuracy is Delta VLBI a differential (spacecraft to quasar) angular measurement scheme which permits spacecraft navigation relative to angularly nearby quasars. Specific objectives of Delta VLBI include (1) demonstrate 50 nano radian Delta VLBI angular measurement accuracy capability and (2) provide technology development required for future quasar-relative spacecraft navigation. This development involves (1) identification of roughly 150 extra galactic radio sources suitable for navigation within 10 deg of the ecliptic plane (2) verification of extra-galactic reference frame stability and (3) determination of the relative orientation of the extra galactic and the planetary ephemeris (i.e. optical) reference frames to within 50 nano radians. A related development effort involves end-to-end system studies for a wide (40 MHz) bandwidth S/X-band automated ranging system with the objective of providing 10 cm ranging in an efficient, cost-effective way

W81-70576 310-10-61

Jet Propulsion Laboratory Pasadena Calif

VLBI DEVELOPMENT AND ANALYSIS

J L Fanslow 213-354-6323
(310-10-60 310-10-62 310-10-62 310-10-63 310-40-74)

The broad objective of this RTOP is development of an understanding of the capabilities and limitations of very long baseline interferometry (VLBI) as a radio metric tool and reduction of the effects of error sources in the application of this technique. This work is required for the DSN because it develops the technology which supports the new generations of VLBI-based tracking systems now being considered for implementation. The FY-81 objectives are hand over to implementation a 30 cm VLBI system and initiate development of a VLBI system accurate to 1 cm. The major areas of concentration will be improvements in antenna microwave calibration in water vapor measurements in software models for the Earth platform and in means of removing the effects of source structure. There is need to provide the same navigation capability to the flight projects for the far outer planets that now exists for the inner planets. This must come from a tenfold improvement in the accuracy of the ground-based DSN radio metric observables. For missions not requiring increased navigation accuracy the improved observable accuracy should lead to reduced antenna tracking times. The VLBI is one of the technologies chosen to achieve these goals. This is done in two ways. First, it is done directly through the application of differential VLBI measuring the angular separation between a spacecraft and a known radio source. This is done under the companion RTOP 60. Second, it is done indirectly through supporting differenced range and Doppler by measuring the relative station locations the difference in rate and epoch offset of station frequency standards Universal time and Earth pole motion. The 30 cm VLBI system now developed sufficiently to commence transfer to implementation achieves the navigation accuracy required only by use of an intercontinental baseline. The 1 cm VLBI system now to be developed will permit the same accuracy to be achieved over a shorter baseline.

W81-70577 310-10-62

Jet Propulsion Laboratory Pasadena Calif

FREQUENCY AND TIMING RESEARCH

R L Sydnor 213-354-2763
(310-10-60 310-10-61 310-20-64 310-30-68)

Increasing navigation and radio science accuracy needs require improvements in the frequency and timing performance of the DSN from 10 to the minus 14 today to 10 to the minus 15 by the mid 80's. The goal for the late 80's is 3×10^{-16} to the minus 16 for navigation and 10 to the minus 17 for certain radio science experiments. Distribution systems which provide time and frequency at remote sites from a central frequency standard with negligible degradation must be developed. Means of synchronizing the overseas complexes to the master station at

DSS 14 to 10 to the minus 8 seconds are necessary to achieve the required navigation accuracies. Automatic monitoring and centralized control are needed to maintain the performance of and assure the reliability of the frequency and timing system. To meet the goals of this RTOP five objectives are established. Definitive tests and analysis of a Smithsonian Astrophysical Observatory VLG-11 maser and a GSFC NR maser will be conducted in order to recommend possible future implementation and developmental work. The technology for a state-of-the-art monitor and control system including unattended operation and remote control will be developed. The technologies (microwave fiber optic and satellites) for precision frequency and time distribution and synchronization within a station complex or network will be studied. The approach includes demonstration of microwave cable and fiber optic frequency and time distribution systems in a field environment, the investigation of a satellite system and demonstration of a VLBI system for time synchronization. Performance and reliability problems of present frequency standards will be solved. The approach is to characterize the problems and to design and demonstrate improved elements which minimize them. Research leading to a new generation frequency standard to meet the performance and reliability goals of the late 80's will be conducted. The approach is to investigate the most promising standards including hydrogen masers, either active cryogenic or passive and trapped ion devices and to design and demonstrate the selected standard.

W81-70578 310-10-63
 Jet Propulsion Laboratory Pasadena Calif
NAVIGATION TECHNOLOGY DEVELOPMENT

M P Ananda 213-354-2804
 (310-10-60 310-10-61)

The primary objectives of this RTOP are to enable the DSN to foresee near and far future radio metric challenges which arise from anticipated navigation needs in Deep Space missions and to equip the DSN with the necessary technology to meet these challenges via identification of the appropriate technology developments and implementations. In order to accomplish the primary objectives of this RTOP four specific research and development themes have been established: (1) drivers for radio metric technology development, (2) streamlining of radio metric data processing, (3) system studies for utility of data types facilities and technology, and (4) orbit determination technology development. The technical approach utilized by this RTOP is to identify and define specific work units under each of these themes. The first theme establishes the need for advanced radio metric technology and investigates the efficient utilization of more machine requirements. The second theme investigates the efficient utilization of more machine interactions and enhanced application of automation in radio metric data processing. Performance of system studies for utility of data types facilities and technology is the prime feature of the third theme. The fourth theme develops techniques for efficient use for navigation of the DSN supplied radio metric observables.

W81-70579 310-20-27
 Goddard Space Flight Center Greenbelt Md
NETWORK TIMING AND SYNCHRONIZATION TECHNOLOGY

A R Ch 301-344-7502

The objectives of this research are to study and develop techniques for time synchronization to coordinate time determination methods and dissemination formats to meet NASA needs and to conduct theoretical investigations and experimental tests for NASA applications. The approach is to develop a satellite time transfer system with which to test a new operational concept of maintaining a clock autonomously to the required accuracy of the user in another satellite or on the ground. The time transfer technique selected from this program is that developed earlier under a joint program between NASA and the Federal Aviation Administration. The propagation path delay can be measured by a two-way satellite time transfer technique and removed if the signal received at the user's station is desired to be on-time relative to the ground station reference clock. If the propagation path delay is known, one-way time transfer technique can be used, limited in accuracy only by the uncertainty

of the path delay. Study results show that the system concept and preliminary hardware design are compatible with the Tracking and Data Relay Satellite System (TDRSS) design and applicable to the new data management concept and the planned goal to achieve spacecraft autonomy.

W81-70580 310-20-33
 Goddard Space Flight Center Greenbelt Md
NETWORK SYSTEMS TECHNOLOGY DEVELOPMENT

J J Schwartz 301-344-7313

The objective of this RTOP is to investigate the applicability of new technology in the TDRSS era. Selected technology will be investigated by means of feasibility studies, prototype development and demonstration, and by cost and reliability impact studies. A major goal will be to carry out preliminary studies of a post-TDRSS tracking and data acquisition system. A second goal is to investigate the effect of non-Gaussian channel characteristics on TDRSS link performance and develop coding and signal designs which can optimize link performance. Associated with this goal is the objective of validating the analytical predictions by means of limited hardware simulations. Third, an investigation will be made of wideband data matrix switches and transmission lines using fiber and integrated optics technology. The feasibility of introducing this technology into the next generation switching systems will be investigated and a prototype switch developed. Other areas include investigations of an integrated receiver system which would be capable of intelligent response to dynamic conditions and the feasibility of a solid state high capacity data storage system.

W81-70581 310-20-38
 Goddard Space Flight Center Greenbelt Md
SATELLITE COMMUNICATIONS TECHNOLOGY

D Wilson 301-344-5257

The objective of this RTOP is to investigate satellite communications technology for application to the NASA Communication (Nascom) Network to provide the best communications services at the lowest cost in support of programs and projects. Initial efforts include (1) the development of communication control techniques which share satellite communications bandwidth between multiple facilities, multiple computers at each facility and multiple users at each computer, and (2) the investigation of the technical feasibility of data transmission systems operating at speeds of 88 to 100 Mbps with error rates of 1×10^{-7} to the minus 7th power or better, utilizing domestic or international satellites C-band transponders. A three-step approach is planned. First, a technical assessment will be made of research in advanced systems test and analyses in these areas. Secondly, advanced techniques that might be used in these areas will be investigated. Thirdly, the technical limitations will be assessed and a course of action would be recommended.

W81-70582 310-20-46
 Goddard Space Flight Center Greenbelt Md
TECHNOLOGY FOR TDRSS USER SPACECRAFT

R P Hockensmith 301-344-9067
 (506-20-45)

The objective of the work under this RTOP is to achieve technological advances in radio frequency (RF) systems, antenna systems, and in data storage. These developments will satisfy future requirements of space mission users (spacecraft and space transportation system payloads) that require near global coverage by the Tracking and Data Relay Satellite System (TDRSS) for support of the mission. The approaches for accomplishing the objective are (1) to identify the basic operational communication requirements, (2) investigate RF active and passive components and antenna systems that are feasible but may be a technical risk to attain the required RF performance, (3) investigate methods of reducing torque noise induced into space platforms due to electromechanical steering of large high gain antennas, (4) investigate methods of high density recording leading to the development of high capacity data storage systems, (5) develop system designs incorporating these optimum subsystems to permit user projects to specify proven reliable hardware with a high confidence level in the performance capability, cost and required

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

procurement cycle and (6) exploit testing techniques that properly characterize these critical systems. The successful accomplishment of the six stated approaches results in minimizing TDRS single access service and maximizing multiple access service without impacting the user missions expectations.

W81-70583 **310-20-64**

Jet Propulsion Laboratory Pasadena Calif

X-BAND UPLINK DEVELOPMENT

R B Kolby 213-354-1662
(310-10-62 310-20-65 310-30-68 310-30-70)

The broad objective of this RTOP is the development of a phase-stable multi-kilowatt automated wideband X-band uplink capability for future DSN missions. This objective is being met by development of a 20 kW transmitter system operating at 7.2 GHz with 5 x 10 to the minus fourteenth power frequency stability. It will be ready in mid-1983 for an X-band uplink demonstration in the DSS 13 unattended operations test bed. Specific FY-81 objectives include (1) completion of the transmitter and exciter subsystem with automation but without final required frequency stability (2) a new microwave cone including a high performance X-band diplexer (3) preliminary integration with the new S-X feed cone being developed in RTOP 65 and (4) telecommunications system support for the demonstration, and continued maintenance of a super power (200 to 400 KW) X-band transmitter capability at DSS 14 for planetary radar. Long term objectives include development of a simultaneous S and X-band uplink capability, development of more reliable super power X-band transmitter capability, development of cryogenically cooled diplexers and development of K-band (32 GHz) transmitter capability. The X-band uplink provides an alternate for the congested S-band uplink and more reliable command and telemetry performance while in two-way lock near solar conjunction. The wide bandwidth ranging possible with X-band uplink promises more precise navigation and radio science. The high phase stability enhances the probability of gravity wave detection. The automation supports the continuing test bed at DSS 13 to verify enhanced network productivity through automation and to provide protection to high power high cost components because of operator errors.

W81-70584 **310-20-65**

Jet Propulsion Laboratory Pasadena Calif

ANTENNA SYSTEMS DEVELOPMENT

R Levy 213-354-3872

This RTOP develops the technology for optimizing communication capabilities of the DSN antenna system and mechanical components for application within the flight-ground communications link of NASA missions to explore the solar system. Measures of communication capabilities are antenna figure of merit, usable operational frequencies, data transmission rates and environmental limits upon operational availability. Technology goals are to optimize the ratios of communication capability to life cycle costs. Advances in ground antenna performance and capabilities are developed within diversified technologies with the goal of achieving cost effective lower noise and higher efficiency performance in the X and K sub a-band frequency range. Microwave technology is applied to provide dual frequency X and S-band feeds as effective alternatives to the present reflex feed systems and to investigate design and demonstrate new offset antennas that have clear apertures and shaped quasi-paraboloidal surfaces. Efficiency improvements are through advancements in structural, mechanical, control and alignment procedures and by electronic compensation or control of the microwave surfaces. Software for design and optimization is developed to facilitate the application of all technologies. Objectives for FY-81 include completion of design and fabrication of dual frequency feed components, continuation of the efficiency and noise reduction studies of clear aperture designs, design and fabrication of a K-band demonstration model, completion of studies of backup structures and mounts for offset antennas, extension of all related design technologies to anticipate needs for K-band operations and application of these to studies for upgrading existing 64-m antennas, development of new electronic and better mechanical CONSCAN techniques for

precision pointing and error calibration, and initiation of studies of automated surface measurement techniques.

W81-70585

310-20-66

Jet Propulsion Laboratory, Pasadena Calif

RADIO SYSTEMS DEVELOPMENT

R C Clauss 213-354-3013
(310-20-65)

The objective of this RTOP is the development of improved ground receiving elements of the spacecraft-ground communication link in order to meet more demanding telecomm performance requirements and achieve greater network productivity. Future missions will require phase stable, versatile, reliable, efficient, low cost receiver elements which permit ultra-stable sensitive wideband simultaneous reception of two or more frequency bands at S, X and K sub a-band. Newer missions will also require noise temperature calibration and modeling of the propagation medium and of the DSN ground radio parameters for efficient link design. One such receiving element is a multifrequency upconverter maser system operating at S, X and K sub a-band (32 GHz) with one or two standard K sub a-band traveling wave masers all in one cryogenic refrigerator. This single wideband unit would be available for all DSN frequencies instead of requiring three or four separate types to be supported logically. Another element is a reliable, efficient, long life, closed cycle refrigerator to hold the 3 W cryogenic package at 4.5 Kelvins. Other elements are a compact wideband K sub a-band maser, cryogenically cooled tunable bandpass filters to permit ultra-low loss in-band interference rejection and a high performance wideband digital receiver. Calibration and modeling of the propagation medium and DSN radio parameters requires thorough radiometer monitoring and establishment of a data base of the statistics of meteorological effects. In addition a thorough analysis of benefits and tradeoffs which can accrue through use of K sub a-band must be made, and key needed technologies identified. Specific FY-81 objectives are to procure and integrate an X-band parametric upconverter to complement the S-band upconverter developed and tested in FY-80, continue testing new ceramic regenerator materials for cryocoolers for enhanced refrigerator reliability, continue testing gadolinium sulfate in adiabatic demagnetization to achieve high reliability 4 Kelvin refrigeration, initiate development of a K sub a-band traveling wave maser, initiate development of fixed rather than tunable K sub a-band cryogenic filter, initiate development of a K sub a-band radiometer, and initiate development of key digital receiver technology.

W81-70586

310-20-67

Jet Propulsion Laboratory, Pasadena, Calif

TELEMETRY TECHNOLOGY DEVELOPMENT

R A Winkelstein 213-354-3843
(310-40-74)

The objective of this RTOP is development of the technology necessary to expand the telemetry data reception and processing capability of the DSN to the 30 Msps region while maintaining or enhancing other DSN system requirements such as low rate telemetry, low detection threshold and precision spacecraft radio metric measurements. To accomplish this objective a developmental program was initiated which will lead to a feasibility model of a telemetry demodulator-detector assembly capable of processing telemetry signals in the region from 100 Kbps to 30 Msps. The necessary test equipment and other support equipment required for this development have been developed or purchased. Simultaneous with this development a commercial off-the-shelf telemetry modulator-demodulator covering approximately this data rate range has been purchased and will be evaluated. These two activities will lead to a thorough understanding of the needs of the DSN concerning multimegabit telemetry and the ability of the commercial sector to satisfy these needs. This knowledge can be used for a make or buy decision. The specific FY-81 objectives are to evaluate the feasibility model demodulator-detector assembly completed in FY-80, evaluate the commercial modem delivered in FY-80 and develop a demonstration in FY-82 to verify compatibility of the developed multimegabit system with other DSN systems such as radio metrics, radio science and antenna arraying. Also in FY-81 this RTOP, until now sharply focused on the development of multimegabit telemetry, will

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

broaden to encompass coding and modulation studies to assess potential techniques for future implementation

W81-70587 310-30-68
Jet Propulsion Laboratory Pasadena Calif
STATION MONITOR AND CONTROL TECHNOLOGY
C F Foster 213-354-5070
(310-20-64)

The objectives of this RTOP are the development and demonstration of technology for unattended tracking station operations and the generation of a data base for assessment of the impact of unattended operations on network productivity and network life-cycle costs. The approach used is the development of a test bed remote controlled unattended station at DSS 13. This test bed includes automated control of an unattended 26-m antenna transmitter and receiver subsystems and data processing subsystem. Control of the equipment is from JPL. This test bed has evolved over several years to include an increasingly comprehensive set of subsystems. Six-month unattended receive capability was demonstrated at DSS 13 during FY-78 and FY-81. Semi-automated data processing has been installed. Emphasis in FY-81 is on automation of the user-peculiar hardware within the station including subsystems for ranging, VLBI and radio astronomy. Additionally, automation of preventive maintenance diagnostics of critical elements such as traveling wave masers is underway and will continue for several years.

W81-70588 310-30-69
Jet Propulsion Laboratory Pasadena Calif
RFI SYSTEMS TECHNOLOGY
H C Wilck 213-354-4298

The broad objective of this RTOP is development of the technology to alleviate the radio frequency interference (RFI) problem confronting the DSN. This requires development of an experimental radio frequency monitoring system to assess the RFI threat to DSN operations, and investigation of promising approaches to reduce DSN sensitivity to RFI. The specific FY-81 objectives are monitoring of the RF environment at the Goldstone DSN complex, development of RFI identification software, development of software to build and manage an RFI event data base, demonstration of the utility of the surveillance system for RFI assessment and support of other surveillance system applications such as radio science experiments. The trailer-housed RFI surveillance system will undergo extensive testing at Goldstone to demonstrate its operational capability and to allow its data collection and RFI detection software to be adapted to the characteristics of the observed RF environment of the DSN complex. The data collected by the surveillance system is recorded on magnetic tape and further processed at JPL in non-real time to enable the development of RFI identification and data base management algorithms. Initially, observations will be made at the Goldstone Operational Support Radar (GOSR) site using the trailer-mounted circular horn antenna and S-band receiver. Later the RFI trailer will be relocated beside DSS 14 and connected to a tap of the DSN's receiver for measuring internally generated RFI. Future tasks for FY-82 and beyond include the upgrading of the surveillance system to 80 MHz bandwidth and X-band capability and the investigation of techniques to desensitize the DSN to RFI.

W81-70589 310-30-70
Jet Propulsion Laboratory, Pasadena Calif
HIGH SPEED SIGNAL PROCESSING RESEARCH
G S Downs 213-354-2765

The objectives of this RTOP are twofold: (1) design, development, building and operation of a test bed at the Goldstone DSN complex for research in high speed signal processing, and (2) application of this test-bed for real-time processing of several different classes of station users including planetary radar, real-time synthetic aperture radar (SAR) data reduction, soft-decision decoding of spacecraft telemetry, short baseline interferometry for spacecraft radio metric navigation analysis of radio frequency interference (RFI) and processing for VLBI or radio astronomy. Since station or complex use is typically for only one application at a time, rapid automated reconfiguration of the test-bed elements permit one processor system for all of

the user classes. The test bed conceptual architecture consists of high speed hardware processor elements all controlled by a computer which can be reconfigured upon command to meet the different user needs. During FY-81 the tasks are to define the requirements of the potential user classes, design the architecture of the processing system and initiate fabrication of specific elements such as a Fast Fourier Transform (FFT) chip under the large scale integration work unit. Definition of the requirements of planetary radar users are already complete. Definition of the SAR and decoding functions require further study of the essential algorithms. Definition of the other user requirements have not been initiated.

W81-70590 310-40-26
Goddard Space Flight Center Greenbelt Md
OPERATIONS SUPPORT COMPUTING TECHNOLOGY
C J McTavish 301-344-8447
(310-10-26)

RTOP 310-40-26 is a subsystem level RTOP currently supporting mission support computing. With the inception of the TDRSS Operations Mission Contract in FY-82, the focus will shift to TDRSS Operations. This RTOP addresses the evolution of Operations Support Computing Technology into the late 1980's and beyond. It accomplishes this through system studies to develop and analyze advanced concepts and system designs, and through concept test and evaluation via prototype implementation of specific capabilities in a controlled environment. System studies in FY-81 will concentrate on modeling of system designs developed in FY-80 and on parametric studies involving capacity planning. Two separate prototype development tasks from FY-80 are being conjoined under this RTOP in FY-81 to provide the concept test and evaluation capability required for developing and demonstrating advanced system concepts in a quasi-operational environment. These tasks focus on the demonstration of human engineering and advanced operational concepts in the mission support computing environment.

W81-70591 310-40-37
Goddard Space Flight Center Greenbelt Md
HUMAN-TO-MACHINE INTERFACE TECHNOLOGY
Walt Truszkowski 301-344-6222

The objective of this RTOP is to develop prototype natural man machine interfaces for space payload and ground systems control. In this context, natural means English-language-like. The intention is to apply recent advances in low-cost computer/microcomputer hardware and artificial intelligence (AI) software techniques augmented with audio and touchtone I/O technology to the man/machine interface problems associated with such systems. The approach to be taken is: first, design and implement prototype man/machine interface systems capable of interacting with design engineers and scientists for the purpose of constructing man/machine interfaces; second, augment the interfaces with audio and touchtone I/O technology; third, develop a man/machine interface-oriented Knowledge Engineering Laboratory and use it to conduct subsystem experimental research. This lab will in effect be an AI workbench which will synthesize the man/machine interface research and be the source of operational versions of the interfaces. This RTOP is a system level RTOP supporting TDRSS Operations Mission Operations and Mission Support Computing.

W81-70592 310-40-45
Goddard Space Flight Center Greenbelt Md
MISSION OPERATIONS TECHNOLOGY
R V Tetrck 301-344-8853

The Mission Operations Technology RTOP is a subsystem level RTOP, the objective of which is to study state of the art hardware and software development and advanced technology concepts for application to the mission operations environment. This is divided into two tasks, Control Center Automation and Distributed Command Management. The Control Center Automation task will study the approaches, benefits and risks to the automation of MSOCC I with specific emphasis on resource scheduling, connection test, operation and documentation for the MSOCC I system. The Distributed Command Management task will first study available microcomputer systems and then

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

implement a Command Management System (CMS) local processing facility based upon the finding of that study and the SMM and DE CMS requirements

W81-70593 **310-40-46**
Goddard Space Flight Center, Greenbelt Md
IMAGE PROCESSING TECHNOLOGY
F W McCaleb 301-344-7819
(310-40-39 506-61-19)

This RTOP supports the development and utilization of image processing technology. It consists of two tasks (1) optical disc technology utilization and (2) ground control point/registration control point (GCP/RCP) library system. Task 1 investigates the utilization of optical disc technology as an input/output image data medium for image processing systems such as those in existence at the GSFC and as potential replacement of high density and computer tapes presently used as archival and intermediate storage. Task 2 is directed to development of multisensor stand-alone and transportable GCP/RCP library system. This system will on a global basis collect and store preselected digital image samples GCPs or RCPs to be used as image registration templates of references in the process of performing geodetic or temporal image registration. In addition the system will be of general purpose so as to enable the collected image samples (points) to be transferred or transported from this library to any image processing system and in so doing have these points properly annotated (e.g. geodetic coordinates, pixel size, orientation, etc.) and formatted for use by the host system. This is a subsystem level RTOP supporting data processing

W81-70594 **310-40-49**
Goddard Space Flight Center Greenbelt Md
SYSTEMS MANAGEMENT TECHNOLOGY
R L Larsen 301-344-7777

The objective of this RTOP is to develop and validate concepts and techniques which can optimize the evolution and operation of Space Tracking and Data Systems (STDs). Its major objectives are (1) the definition, design and evaluation of an STDs data management accounting system on a projectized basis (2) the development of a cost/benefit assessment methodology and its application to crucial STDs design issues and (3) the formulation of a research program to explore the nature of control and decision making in large-scale decentralized systems. The RTOP approach is to develop associated tools and techniques, apply the techniques to representative STDs problems and evaluate both the technique and its results prior to its operational introduction in STDs. The analysis of these specific problems is needed by management in order that the productivity of STDs during the 1980's will be optimized prior to its operational introduction in STDs. The RTOP is a system level activity supporting spacecraft data acquisition, TDRSS operational data processing, mission operations and mission support computing

W81-70595 **310-40-72**
Jet Propulsion Laboratory Pasadena Calif
NETWORK DATA PROCESSING DEVELOPMENT
R C Tausworthe 213-354-2773

The objective of this RTOP is to develop the techniques necessary for the efficient and cost-effective application of computational resources to the jobs of the DSN. Information system engineering methods being devised in this RTOP will improve management control of systems development and facilitate the production of user-responsive functional requirements through detailed software design and implementation tasks. The advanced systems segment of the DSN programming systems work utilizes pathfinder projects such as elements of the DSN programming system to develop and tune an information systems engineering methodology appropriate to DSN needs. This methodology in turn contributes to standard practices and standard tools and languages for DSN implementation in order to improve the overall productivity of the DSN. In past years this RTOP has included RFI identification, control and computational module (CCM) development and software work units. The first has been switched to another RTOP, the second transferred to implementation and the last has been phased into the information systems methodology research work unit in this RTOP

W81-70596 **310-40-73**
Jet Propulsion Laboratory Pasadena Calif
NETWORK PRODUCTIVITY RESEARCH
J H Yuen 213-354-2081
(310-30-68)

The broad objective of this RTOP is to increase the effectiveness of DSN use of NASA resources for telecommunications and data acquisition support of flight projects and other end users. This requires research at the DSN system level to assess the feasibility and cost-effectiveness of future options for improving the planetary telecommunications capability and development of economic tools to permit quantitative assessment of network productivity and cost-effectiveness. The approach used in this RTOP is threefold. One research at the DSN system level will assess the feasibility and cost-effectiveness of future options for improving the planetary telecommunications capability. Second, economic tools are being developed to permit quantitative assessment of network productivity and cost-effectiveness. Finally, detailed assessments will be made of specific concepts which offer promise of meeting particular DSN needs. This allows the full impact of new technology or alternate methods of providing DSN services to be evaluated prior to the expenditure of large amounts of implementation funds. The specific objectives of this RTOP are to develop mathematical models and computer simulations of the DSN from the subassembly level to the network level for economic performance characteristics, compare ten-year life-cycle costs of providing 6 db increase of X and K sub a-band telemetry capability on the spacecraft and at the DSN, assessment of DSN-flight telecommunication system performance capabilities under joint-sponsorship with TSPD, revise Telecommunications System Design Techniques Handbook and evaluate specific post-1990 DSN options such as optical space communication system

W81-70597 **310-40-74**
Jet Propulsion Laboratory Pasadena Calif
ARRAYED NETWORK TECHNOLOGY
A I Zygielbaum 213-354-2745
(310-20-65 310-20-75 310-30-68)

The goal of this RTOP is to provide an evolving technological basis for the development, operation and utilization of arrayed DSN antennas for space telecommunications, tracking and scientific investigation. The program will identify and analyze the operation and application of arrayed systems, model a system or systems satisfying those needs, provide the theoretical foundation to develop the technology, produce prototype control and processing hardware and software and provide a series of demonstrations of automated arrayed reception capability. All aspects of the system from antenna pointing through executive control and data validation are included. While pursuing the long term objective, this RTOP must also in the short term provide the technology to improve the current capability of the DSN to combine signals from different antennas. This cost-effective means to increase receiving aperture must be made more automatic, reliable and operable. The goal is to transfer an intelligent automated combining system to DSN implementation by the end of FY-83. In response to the current needs for arraying of DSN antennas (such as Voyager Uranus encounter) the RTOP will in FY-81 (1) initiate the development of an intelligent real-time combining system, (2) develop the hardware and software for the accurate measurement of low SNR, (3) develop techniques to array suppressed carrier signals and (4) develop techniques, hardware and software to point, calibrate and measure the performance of arrayed systems. To initiate the broader task of creating the technology to efficiently, effectively and reliably array deep space telecommunications antennas, the following will be funded: (1) development of a system simulator to facilitate system and component research, (2) analysis of whether and when combining should be done at carrier, subcarrier or symbol level, (3) analysis to determine the optimum waveform for combining and (4) measurement and analysis of the tropospheric instabilities that will affect carrier combining.

OFFICE OF SPACE TRANSPORTATION SYSTEMS

Advanced Programs

W81-70598 906-55-00

Lyndon B Johnson Space Center Houston Tex

LARGE SPACE STRUCTURE SYSTEM ENGINEERING

Richard C Kennedy 713-483-4083

The objectives of this RTOP are to develop an understanding of space construction requirements for NASA programs of the 1980's and to identify and develop the tools techniques ground test hardware and flight development activities necessary to insure that these programs can be implemented when approved (This activity complements the OAST funded large space structures technology activities conducted at JSC and other centers) The concept of beam machines which convert raw stock into structural components is one of the most promising candidates for the large space structures envisioned in the late 1980's Two automated beam machine concepts continue to be researched by JSC Both systems are adaptable to composite materials which combine structural strength with a very low coefficient of thermal expansion Materials research involving magnesium lithium graphite composites will be pursued as a lightweight space structural material

W81-70599 906-75-00

Lyndon B Johnson Space Center Houston, Tex

SATELLITE SERVICES

Richard C Kennedy 713-483-4083

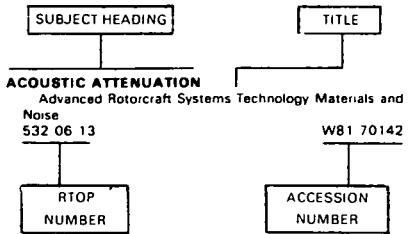
The Shuttle mission model identifies many payload deployment and retrieval requirements beyond the capability of the basic Shuttle system Satellites such as the Multi-Mission Satellite (MMS) and Space Telescope require periodic servicing Studies of some future space systems show that longer operational lifetimes are necessary for long duration low-cost operation and that a servicing capability including maintenance repair and refurbishment will be required Studies of possible flux densities of non-functional satellites and debris in the year 2000 time period show results indicating potential hazards to space flight It is now timely for the development of a satellite services capability for a cost effective means of meeting early payload needs and to meet longer term requirements for dealing with maintenance and satellite removal requirements This RTOP includes the definition design development fabrication and flight testing for engineering and operational verification of key elements of a satellite services system These services include deployment and retrieval of payloads earth-return and general satellite support

SUBJECT INDEX

FISCAL YEAR 1981

RTOP Summary

Typical Subject Index Listing



A title is used to provide a more exact description of the subject matter. The RTOP accession number is used to locate the bibliographic citations and technical summaries in the Summary Section.

A

ABLATION	Planetary Probe Aerothermodynamic Technology	506 51 21	W81 70175
Planetary Probe Technology		506 51 23	W81 70176
ABLATIVE MATERIALS	OEX Thermal Protection Experiments	506 63 36	W81 70275
ABUNDANCE	Advanced Infrared Astronomy and Laboratory	196 41 54	W81 70523
ACCELERATED LIFE TESTS	Life Prediction for Composite Materials	505 33-23	W81 70035
Composites		505 33-33	W81 70038
ACCIDENT PREVENTION	Aviation Safety Technology -Flight Safety	505 44-23	W81-70109
ACOUSTIC ATTENUATION	Advanced Rotorcraft Systems Technology Materials and Noise	532 06-13	W81-70142
ACOUSTIC MEASUREMENTS	Rotorcraft Aerodynamics Scale Modeling	505 42-23	W81-70084
ACOUSTICS	Aeronautics Graduate Research Program FY 1981	505-36-21	W81-70066
Low Speed Propeller Research		505 41-52	W81-70076
Advanced Turboprop Interior Noise		535 03 13	W81 70170
Payload Environments and Dynamics		506 53-66	W81 70205
Space Vehicle Dynamics		506 53-69	W81 70206
Advanced Containerless Processing Technology		179 20-55	W81 70367
Acoustic Containerless Experiment System (ACES)		179 70 10	W81 70370
Systems for Underwater Survey and Exploration (SUSE)		637-01-02	W81 70381
ACOUSTO-OPTICS	Signal Detection and Processing Filters and Receivers	506-54 56	W81-70213
ACTIVE CONTROL	Loads Aeroelasticity and Structural Dynamics	505-33 53	W81 70040
Aeronautical Structural Design Methods		505-33-63	W81 70044
Aircraft Controls Theory and Techniques		505-34 33	W81 70051
Flight Dynamics and Handling Qualities		505-43 14	W81 70092
Integrated Research Aircraft Control Technology		533-02 44	W81 70153
ADAPTIVE CONTROL	Energy Efficient Transport	534 02 13	W81-70160
Energy Efficient Transport Flight Research		534 02 14	W81 70161
Terminal Configured Vehicle Program		534 04-13	W81 70164
ACTUATORS	Aircraft Controls Electromechanical Actuator	Technology	
505 34-37		W81 70053	
Intelligent Systems Research		506 54-83	W81 70222
ADAPTIVE CONTROL	NASA End to End Data System	Information Adaptive System	
506 61-53		W81 70260	
NASA End-to-End Data System		506 61-55	W81 70261
NASA End-to-End Data System (NEEDS) Phase 2		506-61-56	W81 70262
Synthetic Aperture Radar Processor		656-62-01	W81 70400
ADHESIVES	Composites	505-33-33	W81 70038
ADSORPTION	Mars Data Analysis Studies	155 20-70	W81 70481
AERIAL PHOTOGRAPHY	Tectonic Structure in Pakistan	677-43 03	W81 70426
AERIAL RECONNAISSANCE	Severe Storms and Local Weather Research	146-50-02	W81 70344
Ozone Data Reduction and Analysis and Solar UV Variability		146-60 01	W81 70346
Laser Heterodyne Spectrometer (LHS) Brassboard		147-40-01	W81-70366
Extended Scene Radar Calibration		677-47 02	W81 70433
AEROACOUSTICS	Graduate Research Program in Aeronautics	505-36 22	W81 70067
Advanced Turboprop Program		535-03 12	W81 70169
AERODYNAMIC CHARACTERISTICS	Computational Methods and Applications in Fluid Dynamics	505-31 11	W81 70001
505-31 33		505-31 41	W81 70006
Aerodynamic Theory/Experimental Integration		505-31 43	W81 70007
Configuration Aerodynamics		505 31 51	W81-70008
Aerodynamic Test Methods and Instrumentation		505 31 51	W81-70010
Experimental Methods and Instrumentation		505 31 53	W81-70011
General Aviation Aerodynamics and Handling Qualities Technology		505 41 13	W81 70071
Flight Vehicle Dynamics		505 43 11	W81 70090
Flight Dynamics		505 43 13	W81 70091
Interagency and Industrial Assistance and Testing		505 43 33	W81 70097
V/STOL Systems Technology		532 05 11	W81 70139
V/STOL Propulsion System Technology		532 05-12	W81 70140
SRC Aerodynamic Performance Technology		533 01-43	W81 70147
Space Shuttle Aerodynamic Experiments		506 51-34	W81 70179
Aerodynamics of Ground Vehicles		141 20-11	W81 70316
AERODYNAMIC COEFFICIENTS	Aerodynamic/Aerothermodynamic Flight Data Analysis	506-51-33	W81 70178
ACIP - (Aerodynamic Coefficient Identification Package)		506-63-27	W81 70270
AERODYNAMIC CONFIGURATIONS	Computational Methods and Applications in Fluid Dynamics	505-31-11	W81 70001
Computational Fluid Dynamics		505-31-13	W81 70002
Full Space Reynolds Number Test Technology		505 31-63	W81 70013
AEROELASTICITY	Computational Fluid Mechanics for Turbomachinery	505 32 52	W81 70025
Loads Dynamics and Aeroelasticity		505 33 52	W81-70039
Loads Aeroelasticity and Structural Dynamics		505 33 53	W81-70040
Flight Loads and Aeroelasticity		505 33 54	W81-70041
Graduate Research Program in Aeronautics		505 36 22	W81-70067
Low Speed Propeller Research		505 41 52	W81-70076
Rotocraft Aeroelasticity and Structural Dynamics		505 42 11	W81 70081

Rotocraft Structures Vibration Aeroelasticity and Acoustics	W81 70082	Space Systems and Planning Analysis	W81-70286
505-42 13 Flight Dynamics and Handling Qualities	W81 70092	AEROSPACE ENVIRONMENTS	
505 43 14 Interagency and Industrial Assistance and Testing	W81 70097	Space Engineering	W81 70187
505 43 33 Aeroelasticity of Turbine Engines	W81 70119	Effects of Space Environment on Composites	W81 70193
510 55 12 SCR-Materials and Structures	W81 70144	Long Term Space Environmental Effects on Materials	W81 70194
533 01 13 Energy Efficient Transport Flight Research	W81 70161	Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array	W81 70290
534-02 14 AERONAUTICAL ENGINEERING		Space Calibration of Solar Cells	W81-70292
Funds for Independent Research (Aeronautics)		542-03-20	
505-36-11 Fund for Independent Research (Aeronautics)	W81 70061	Tribological Experiments in Zero Gravity	W81 70293
505 36-12 Fund for Independent Research (Aeronautics)	W81 70062	Semiconductor Materials Growth in Low-g Environment	W81 70294
505 36 13 Fund for Independent Research	W81 70063	Cryogenic Fluid Management	W81 70295
505 36 14 Aeronautics Graduate Research Program	W81 70064	Space Plasma Physics	W81 70548
505 36 21 Graduate Research Program in Aeronautics	FY 1981	AEROSPACE MEDICINE	
505 36 22 Graduate Program in Aeronautics	W81 70067	Systems Habitability Verification	W81 70537
505 36-23 University Research in Flight Testing Techniques	W81 70068	199 10 41	
505 36-24 Propulsion Systems for Small Transports	W81 70069	Space Motion Sickness	W81 70538
530-04-12 Advanced Propulsion System Concepts	W81 70129	199-20 00	
530 05 12 General Aviation Advanced Avionics Systems	W81 70131	Interdisciplinary Research	W81 70547
531 01 11 Rotorcraft Operating Systems Technology	W81 70132	AEROSPACE SCIENCES	
532 01 11 Quiet Propulsive Lift Technology Experiments	W81 70133	Funds for Independent Research (Space)	W81 70244
Performance and Operating Systems Research		506 56 11	
532 02 11 Advanced Rotor Systems Technology/RSRA Operations	W81 70134	Fund for Independent Research (Space)	W81 70246
532-03 11 Advanced Power System Technology	W81 70136	506 56 13	
506-55-76	W81 70242	Fund for Independent Research	W81 70248
AERONOMY		506 56 19	
Aeronomy Theory and Analysis		Space Applications of Automation Robotics and Machine Intelligence Systems (ARAMIS)	W81 70283
154 60-80 Cosmic Chemistry Aeronomy Comets Grains	W81-70468	540 02 19	
154 75-80 Aeronomy of Planetary Atmospheres Chemistry	W81-70471	Interdisciplinary Space Science Research	W81 70514
154 75-80 Extended Atmospheres	W81-70472	188-48 51	
154 80 80	W81-70474	AEROSPACE SYSTEMS	
AEROSOLS		Technology Requirements of Future Integrated Space Transportation Systems	W81 70284
Aviation Operations Safety Technology	Applied Laser Technology	540-03 13	
505-44 29	W81-70113	Space Systems and Planning Analysis	W81 70286
Aerosol Climatic Effects Special Study		540-04 10	
146-10 04 Radiation Budget and Aerosol Studies	W81 70325	AEROSPACE TECHNOLOGY TRANSFER	
146-10-06	W81 70326	Aircraft Controls Electromechanical Actuator Technology	W81 70053
Theoretical Studies of the Upper Tropospheric Aerosol Layer and Sahara Dust		505-34 37	
146-20-23	W81 70329	Communication Satellite Application Systems	W81 70377
Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere		643-10 02	
147 10 02 Atmospheric Processes Experiments and Systems	W81 70355	OSTA Data Systems Standards and Guidelines	W81-70390
147 10 03 Planetary Atmospheres Composition and Structure	W81 70356	656-13 10	
154 10 80 Planetary Clouds Particulates and Ices Clouds of Venus	W81-70458	OSTA/ADS Data Systems Standards and Guidelines Program	W81 70391
154-30 80 Planetary Atmospheres Data Analysis	W81 70462	656-13 20	
155-04 80 Theoretical Planetary Astronomy	W81 70479	Full Scale Applications Data Service (ADS) Planning Studies	W81 70392
196-41-85	W81 70533	AEROSPACE VEHICLES	
AEROSPACE ENGINEERING		Funds for Independent Research	W81 70064
Integrated Programs for Aerospace Vehicle Design (IPAD)		505 36 14	
510 54-13 Aeroelasticity of Turbine Engines	W81 70118	High Temperature Structures	W81-70045
510 55-12 Fund for Independent Research (Space)	W81 70119	505 33-72	
506 56 12 Large Space Structures Systems Technology	W81-70245	Computational and Experimental Aerothermodynamics	W81 70173
506 62 43 Thermal Management for On-Orbit Energy Systems	W81 70264	506-51 11	
506-62 67 ACIP - (Aerodynamic Coefficient Identification Package)	W81 70267	Space Vehicle Aerothermodynamics and Configuration Technology	W81 70174
506-63 27	W81 70270	506-51 13	
OEX (Orbiter Experiments) Project Support	W81 70271	Planetary Probe Aerothermodynamic Technology	W81 70175
506-63-31	W81 70272	506-51 21	
Space System Studies Information and Spacecraft Systems	W81-70280	Aerodynamic/Aerothermodynamic Flight Data Analysis	W81 70178
540 02-11 Technology Requirements of Future Integrated Space Transportation Systems	W81 70284	506 51-33	
Shuttle Derived Vehicle Technology Requirements	W81-70285	Space Shuttle Configuration and Aerothermodynamics	W81-70268
540 03 13	W81 70286	506-63-11	
540 03 19	W81-70287	Space Shuttle Development Support	W81-70269
540 03-14		506-63-13	
540 04-13		ACIP - (Aerodynamic Coefficient Identification Package)	
540 04-14		506-63 27	
540 04-15		OEX (Orbiter Experiments) Project Support	W81 70270
540 04-16		506-63 31	
540 04-17		Shuttle Entry Air Data System (SEADS)	W81 70271
540 04-18		506-63 32	
540 04-19		Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81 70272
540 04-20		506-63 34	
540 04-21		Infrared Imagery of Shuttle	W81 70273
540 04-22		506-63-35	
540 04-23		OEX Thermal Protection Experiments	W81-70274
540 04-24		506 63-36	
540 04-25		Marx Data Analysis	W81 70275
540 04-26		155 04-80	
540 04-27		AEROTHERMODYNAMICS	W81 70478
540 04-28		155 04-80	
540 04-29		AEROTHERMODYNAMICS	
540 04-30		155 04-80	
540 04-31		AEROTHERMODYNAMICS	
540 04-32		155 04-80	
540 04-33		AEROTHERMODYNAMICS	
540 04-34		155 04-80	
540 04-35		AEROTHERMODYNAMICS	
540 04-36		155 04-80	
540 04-37		AEROTHERMODYNAMICS	
540 04-38		155 04-80	
540 04-39		AEROTHERMODYNAMICS	
540 04-40		155 04-80	
540 04-41		AEROTHERMODYNAMICS	
540 04-42		155 04-80	
540 04-43		AEROTHERMODYNAMICS	
540 04-44		155 04-80	
540 04-45		AEROTHERMODYNAMICS	
540 04-46		155 04-80	
540 04-47		AEROTHERMODYNAMICS	
540 04-48		155 04-80	
540 04-49		AEROTHERMODYNAMICS	
540 04-50		155 04-80	
540 04-51		AEROTHERMODYNAMICS	
540 04-52		155 04-80	
540 04-53		AEROTHERMODYNAMICS	
540 04-54		155 04-80	
540 04-55		AEROTHERMODYNAMICS	
540 04-56		155 04-80	
540 04-57		AEROTHERMODYNAMICS	
540 04-58		155 04-80	
540 04-59		AEROTHERMODYNAMICS	
540 04-60		155 04-80	
540 04-61		AEROTHERMODYNAMICS	
540 04-62		155 04-80	
540 04-63		AEROTHERMODYNAMICS	
540 04-64		155 04-80	
540 04-65		AEROTHERMODYNAMICS	
540 04-66		155 04-80	
540 04-67		AEROTHERMODYNAMICS	
540 04-68		155 04-80	
540 04-69		AEROTHERMODYNAMICS	
540 04-70		155 04-80	
540 04-71		AEROTHERMODYNAMICS	
540 04-72		155 04-80	
540 04-73		AEROTHERMODYNAMICS	
540 04-74		155 04-80	
540 04-75		AEROTHERMODYNAMICS	
540 04-76		155 04-80	
540 04-77		AEROTHERMODYNAMICS	
540 04-78		155 04-80	
540 04-79		AEROTHERMODYNAMICS	
540 04-80		155 04-80	
540 04-81		AEROTHERMODYNAMICS	
540 04-82		155 04-80	
540 04-83		AEROTHERMODYNAMICS	
540 04-84		155 04-80	
540 04-85		AEROTHERMODYNAMICS	
540 04-86		155 04-80	
540 04-87		AEROTHERMODYNAMICS	
540 04-88		155 04-80	
540 04-89		AEROTHERMODYNAMICS	
540 04-90		155 04-80	
540 04-91		AEROTHERMODYNAMICS	
540 04-92		155 04-80	
540 04-93		AEROTHERMODYNAMICS	
540 04-94		155 04-80	
540 04-95		AEROTHERMODYNAMICS	
540 04-96		155 04-80	
540 04-97		AEROTHERMODYNAMICS	
540 04-98		155 04-80	
540 04-99		AEROTHERMODYNAMICS	
540 04-100		155 04-80	
540 04-101		AEROTHERMODYNAMICS	
540 04-102		155 04-80	
540 04-103		AEROTHERMODYNAMICS	
540 04-104		155 04-80	
540 04-105		AEROTHERMODYNAMICS	
540 04-106		155 04-80	
540 04-107		AEROTHERMODYNAMICS	
540 04-108		155 04-80	
540 04-109		AEROTHERMODYNAMICS	
540 04-110		155 04-80	
540 04-111		AEROTHERMODYNAMICS	
540 04-112		155 04-80	
540 04-113		AEROTHERMODYNAMICS	
540 04-114		155 04-80	
540 04-115		AEROTHERMODYNAMICS	
540 04-116		155 04-80	
540 04-117		AEROTHERMODYNAMICS	
540 04-118		155 04-80	
540 04-119		AEROTHERMODYNAMICS	
540 04-120		155 04-80	
540 04-121		AEROTHERMODYNAMICS	
540 04-122		155 04-80	
540 04-123		AEROTHERMODYNAMICS	
540 04-124		155 04-80	
540 04-125		AEROTHERMODYNAMICS	
540 04-126		155 04-80	
540 04-127		AEROTHERMODYNAMICS	
540 04-128		155 04-80	
540 04-129		AEROTHERMODYNAMICS	
540 04-130		155 04-80	
540 04-131		AEROTHERMODYNAMICS	
540 04-132		155 04-80	
540 04-133		AEROTHERMODYNAMICS	
540 04-134		155 04-80	
540 04-135		AEROTHERMODYNAMICS	
540 04-136		155 04-80	
540 04-137		AEROTHERMODYNAMICS	
540 04-138		155 04-80	
540 04-139		AEROTHERMODYNAMICS	
540 04-140		155 04-80	
540 04-141		AEROTHERMODYNAMICS	
540 04-142		155 04-80	
540 04-143		AEROTHERMODYNAMICS	
540 04-144		155 04-80	
540 04-145		AEROTHERMODYNAMICS	
540 04-146		155 04-80	
540 04-147		AEROTHERMODYNAMICS	
540 04-148		155 04-80	
540 04-149		AEROTHERMODYNAMICS	
540 04-150		155 04-80	
540 04-151		AEROTHERMODYNAMICS	
540 04-152		155 04-80	
540 04-153		AEROTHERMODYNAMICS	
540 04-154		155 04-80	
540 04-155		AEROTHERMODYNAMICS	
540 04-156		155 04-80	
540 04-157		AEROTHERMODYNAMICS	
540 04-158		155 04-80	
540 04-159		AEROTHERMODYNAMICS	
540 04-160		155 04-80	
540 04-161		AEROTHERMODYNAMICS	
540 04-162		155 04-80	
540 04-163		AEROTHERMODYNAMICS	
540 04-164		155 04-80	
540 04-165		AEROTHERMODYNAMICS	
540 04-166		155 04-80	
540 04-167		AEROTHERMODYNAMICS	
540 04-168		155 04-80	
540 04-169		AEROTHERMODYNAMICS	
540 04-170		155 04-80	
540 04-171		AEROTHERMODYNAMICS	
540 04-172		155 04-80	
540 04-173		AEROTHERMODYNAMICS	
540 04-174		155 04-80	
540 04-175		AEROTHERMODYNAMICS	
540 04-176		155 04-80	
540 04-177		AEROTHERMODYNAMICS	
540 04-178		155 04-80	
540 04-179		AEROTHERMODYNAMICS	
540 04-180		155 04-80	
540 04-181		AEROTHERMODYNAMICS	
540 04-182		155 04-80	
540 04-183		AEROTHERMODYNAMICS	
540 04-184		155 04-80	
540 04-185		AEROTHERMODYNAMICS	
540 04-186		155 04-80	
540 04-187		AEROTHERMODYNAMICS	
540 04-188		155 04-80	
540 04-189		AEROTHERMODYNAMICS	
540 04-190		155 04-80	
540 04-191		AEROTHERMODYNAMICS	
540 04-192		155 04-80	
540 04-193		AEROTHERMODYNAMICS	
540 04-194		155 04-80	
540 04-195		AEROTHERMODYNAMICS	
540 04-196		155 04-80	
540 04-197		AEROTHERMODYNAMICS	
540 04-198		155 04-80	
540 04-199		AEROTHERMODYNAMICS	
540 04-200		155 04-80	
540 04-201		AEROTHERMODYNAMICS	
540 04-202		155 04-80	
540 04-203		AEROTHERMODYNAMICS	
540 04-204		155 04-80	
540 04-205		AEROTHERMODYNAMICS	
540 04-206		155 04-80	
540 04-207		AEROTHERMODYNAMICS	
540 04-208		155 04-80	
540 04-209		AEROTHERMODYNAMICS	
540 04-210		155 04-80	
540 04-211		AEROTHERMODYNAMICS	
540 04-212		155 04-80	
540 04-213		AEROTHERMODYNAMICS	
540 04-214		155 04-80	
540 04-215		AEROTHERMODYNAMICS	
540 04-216		155 04-80	
540 04-217		AEROTHERMODYNAMICS	
540 04-218		155 04-80	
540 04-219		AEROTHERMODYNAMICS	
540 04-220		155 04-80	
540 04-221		AEROTHERMODYNAMICS	
540 04-222		155 04-80	
540 04-223		AEROTHERMODYNAMICS	
540 04-224		155 04-80	
540 04-225		AEROTHERMODYNAMICS	
540 04-226		155 04-80	
540 04-227		AEROTHERMODYNAMICS	
540 04-228		155 04-80	
540 04-229		AEROTHERMODYNAMICS	
540 04-230		155 04-8	

Aerosol Climatic Effects Special Study	W81-70325	Advanced Operations	Rotor	Systems	Technology/RSRA	Advanced Low Emission Combustor (ALEC)	W81 70121
146-10-04		532-03 11	Advanced Flight	Experiments	W81 70136	511 55 12	Broad Property Fuels Technology
Airborne Water Vapor Lidar		533-02 34	F-14	High		511 59 12	W81 70123
146-30-03	W81-70332	Angle-of-Attack			W81 70152	V/STOL Propulsion System Technology	W81 70140
Atmospheric Processes Experiments and Systems	W81 70356	Integrated Research Aircraft Control Technology			532-05-12	Propulsion System/Airframe Integration Technology	W81-70148
147-10-03		533-02-44	W81 70153	533 01-62	SCR - Airframe/Propulsion System Interactions	533-01-63	W81-70149
Aircraft Thermal Infrared Scanner		533-02-64	Highly Maneuvering Aircraft Technology		Energy Efficient Engine Project	535-01-12	W81-70167
677-47-01	W81 70432	533-03 13	W81-70156	535-02-12	Variable Cycle Engine Technology	535-02-12	W81 70168
Planetary Atmospheric Dynamics		Laminar Flow Control (Leading Edge Glove) - Flight					
154-20-80	W81 70459	Research		W81-70158			
AIRBORNE/SPACEBORNE COMPUTERS		534-01 14	Energy Efficient Transport				
Navigation and Guidance Short-Range Operations		534-02 13	W81-70160				
505 34 11	W81 70047						
Aircraft Controls Theory and Techniques							
505 34 33	W81 70051						
Precision Pointing and Control Technology (PPACT)							
Development							
506 54 95	W81 70225						
NASA End-to-End Data System Information Adaptive System							
506 61 53	W81 70260						
NASA End-to-End Data System							
506 61 55	W81-70261						
NASA End-to-End Data System (NEEDS) Phase 2							
506 61-56	W81-70262						
Planetary Atmosphere Experiment Development							
154-90-80	W81-70477						
AIRCRAFT ACCIDENTS							
Aviation Safety Technology - Operational Problems and Fireworthiness							
505-44-21	W81-70107						
Aviation Safety Technology- Flight Safety							
505-44-23	W81-70109						
Wallops Flight Center Research Airport Support							
534-04 18	W81 70165						
AIRCRAFT COMMUNICATION							
General Aviation Avionics and Control Technology							
505-41-63	W81 70077						
General Aviation Avionics and Controls							
505 41-68	W81 70078						
General Aviation Single Pilot IFR Systems							
505 41 73	W81 70079						
AIRCRAFT CONFIGURATIONS							
Propulsion System Integration							
505 32 13	W81 70021						
Flight Dynamics							
505 43-13	W81-70091						
High Performance Aircraft Airframe Propulsion Integration							
505 43 21	W81-70093						
Combat Veh & Missile Aerodyn & Flight Dyn R & T							
505 43-22	W81-70094						
Low Speed Aircraft Systems Studies							
530 02 11	W81-70127						
Long Haul Transport Aircraft Systems Studies							
530 04 13	W81-70130						
V/STOL Systems Technology							
532-05-11	W81 70139						
SRC Aerodynamic Performance Technology							
533-01 43	W81 70147						
Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F-111)							
533-02 14	W81 70150						
Highly Maneuvering Aircraft Technology							
533-03 13	W81 70156						
Energy Efficient Transport							
534-02 13	W81 70160						
Advanced Turboprop Program							
535-03 12	W81 70169						
Advanced Turboprop Interior Noise							
535 03 13	W81 70170						
AIRCRAFT CONSTRUCTION MATERIALS							
Life Prediction for Composite Materials							
505 33 23	W81 70035						
Fire Resistant Materials							
505 33 31	W81 70036						
Composites							
505 33 33	W81 70038						
Interdisciplinary Research in Composite Structures							
505 33 60	W81 70042						
Aircraft Fire Safety and Testing							
505 44-27	W81 70111						
Composite Components Technology							
534-03 13	W81-70162						
Large Composite Primary Aircraft Structures (LCPAS)							
Key Technology							
534-03-33	W81 70163						
AIRCRAFT CONTROL							
Aircraft Controls Reliability Enhancement							
505 34-31	W81-70049						
Aircraft Controls Theory and Techniques							
505 34-33	W81 70051						
Aircraft Controls Flight Systems Concepts							
505 34-34	W81 70052						
Integration and Interfacing Technology							
505 34 43	W81 70054						
Flight Dynamics and Handling Qualities							
505-43 14	W81 70092						
Advanced Guidance and Control Systems Validation Technology							
512-54 11	W81 70124						
Advanced Guidance and Control Flight Systems Experiments							
512 54 14	W81 70125						
AIRCRAFT ENGINES							
Propulsion Noise Research							
505 32 02	W81 70017						
Inlet Nozzle and Propeller Research							
505 32 12	W81 70020						
Propulsion System Integration							
505 32 13	W81 70021						
Combustion and Emissions Reduction Research							
505 32-32	W81 70023						
Composites for Propulsion Components							
505-33-32	W81 70037						
Loads Dynamics and Aeroelasticity							
505-33-52	W81 70039						
Electronic Aircraft Engine Control							
505-34-32	W81 70050						
Aircraft Operational Support							
505-43 54	W81 70100						
Materials for Advanced Turbine Engines (MATE)							
510-53 12	W81 70117						
Aeroelasticity of Turbine Engines							
510-55 12	W81 70119						
Turbine Engine Hot Section Technology (HOST)							
510 57 12	W81-70120						
AIRCRAFT NOISE							
Propulsion Noise Research							
505 32 03	W81 70018						
Loads Aeroelasticity and Structural Dynamics							
505 33-53	W81 70040						
Human Response to Noise							
505-35 13	W81-70055						
Rotocraft Structures Vibration Aeroelasticity and Acoustics							
505 42 13	W81 70082						
Rotocraft Aerodynamic Performance Dynamics and Handling Qualities							
505-42-21	W81 70083						
Rotocraft Aerodynamics Scale Modeling							
505-42-23	W81-70084						
Low Speed Aircraft Systems Studies							
530-02 11	W81-70127						
QPLT Systems Technology							
532-02 12	W81-70135						
Advanced Rotocraft Systems Technology-Materials and Noise							
532-06-13	W81 70142						
SCR Propulsion Technology							
533-01 32	W81 70146						
Advanced Turboprop Flight Research							
535 03 14	W81 70171						

AIRCRAFT PERFORMANCE

Propulsion System Integration	W81 70021
General Aviation Aerodynamics and Handling Qualities Technology	W81 70071
505 41 13 Interagency and Industrial Assistance and Testing	W81 70096
505-43-31 Interagency and Industrial Assistance and Testing	W81 70097
505 43-33 Interagency Assistance and Testing	W81 70098
505 43 34 Remotely Piloted Research Aircraft Technology	W81 70099
505 43 44 Aircraft Operational Support	W81 70100
505 43 54 Aviation Meteorology Research	W81 70101
505-44 12 General Aviation System Technology Studies	W81 70126
530 01 13 Low Speed Aircraft Systems Studies	W81 70127
530-02 11 Energy Efficient Transport Wind Tunnel Testing	W81-70159
534-02 11 Terminal Configured Vehicle Program	W81 70164
534-04-13	W81 70166

AIRCRAFT PRODUCTION

High Temperature Aeronautical Structures	W81 70046
505-33-73 Composite Components Technology	W81 70162
534 03-13	W81 70164

AIRCRAFT RELIABILITY

Integrated Avionic Control Systems for Rotorcraft	W81 70085
505-42-31 Aviation Safety Technology Flight Safety	W81 70109
505 44 23	W81 70109

AIRCRAFT SAFETY

General Aviation Aircraft Aerodynamics and Flight Dynamics	W81 70072
505 41 18 General Aviation Crash Dynamics	W81 70074
505 41-33 Low Speed Propeller Research	W81 70076
505 41 52 General Aviation Avionics and Control Technology	W81 70077
505 41-63 General Aviation Avionics and Controls	W81 70078
505 41-68 General Aviation Single Pilot IFR Systems	W81 70079
505 41 73 Aviation Meteorology Research	W81 70101
505 44-12 Aviation Meteorology Research Severe Storms	W81 70102
505 44 13 Knowledge of High Altitude Atmospheric Processes	W81 70103
505 44-14 Microwave Technology Development for Atmospheric Turbulence Studies	W81 70104
505 44 15 Aviation Meteorology Research Atmospheric Dynamics & Measurement Tech	W81 70105
505-44 18 Aviation Meteorology Research Basic Atmospheric Processes	W81 70106
505 44 19 Aviation Safety Technology Operational Problems and Fireworthiness	W81 70107
505 44-21 Aviation Operations Safety Technology	W81 70108
505 44 22 Aviation Safety Technology- Flight Safety	W81 70109
505 44-23 Aviation Safety Technology Applied Fluid Mechanics	W81 70110
505 44-25 Aviation Operations Safety Technology Wind Shear and Collision Avoidance	W81 70112
505-44 28 Aviation Operations Safety Technology Applied Laser Technology	W81 70113
505 44 29 Aircraft Systems Operational Safety and Efficiency Improvement	W81 70114
505 44 31 General Aviation System Technology Studies	W81 70126
530 01 13 Low Speed Aircraft Systems Studies	W81 70127

AIRCRAFT SPIN

Flight Vehicle Dynamics	W81-70090
505 43 11 Flight Dynamics	W81-70091
505 43 13	W81 70146

AIRCRAFT STABILITY

SCR Propulsion Technology	W81 70146
533-01-32 Decoupler Pylon Flight Demonstration	W81 70155
533 02 73 Highly Maneuvering Aircraft Technology	W81 70156

AIRCRAFT STRUCTURES

Advanced Aluminum Alloys	W81 70032
505-33-13 Loads Aeroelasticity and Structural Dynamics	W81-70040
505 33 53	W81 70040

Flight Loads and Aeroelasticity

505 33 54 High Temperature Aeronautical Structures	W81 70041
505-33-73 Advanced Propulsion System Concepts	W81 70046
530-05 12 SCR Materials and Structures	W81-70131
533 01 13 SCR Materials and Structures Flight Research	W81 70144
533-01 14 SRC Aerodynamic Performance Technology	W81 70145
533 01 43 Composite Components Technology	W81-70147
534-03 13 Large Composite Primary Aircraft Structures (LCPAS)	W81 70162
Key Technology	W81 70163

AIRCRAFT SURVIVABILITY**Fire Systems Full Scale Test**

534 05 17	W81 70166
-----------	-----------

AIRCRAFT TIRES

Aircraft Systems Operational Safety and Efficiency Improvement	W81-70114
Aircraft Landing Systems Efficiency Improvements	W81 70116

AIRFOIL PROFILES

Airfoil Development	W81 70006
505-31-33	W81 70006

AIRFOILS**Airfoil and Wing Development**

505-31 31	W81 70005
-----------	-----------

AIRFRAME MATERIALS**High Temperature Aeronautical Structures**

505 33 73	W81 70046
Advanced Rotorcraft Systems Technology-Materials and Noise	W81-70070

Noise

532 06 13	W81 70142
-----------	-----------

SCR Materials and Structures Flight Research

533 01 14	W81 70145
-----------	-----------

SCR - Aerodynamic Performance Technology

533 01-43	W81 70147
-----------	-----------

Large Composite Primary Aircraft Structures (LCPAS)

Key Technology	W81 70163
----------------	-----------

AIRFRAMES**Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research**

505-42-71	W81 70088
-----------	-----------

High Performance Aircraft Airframe Propulsion Integration

505-43-21	W81 70093
-----------	-----------

Propulsion System/Airframe Integration Technology

533 01 62	W81 70148
-----------	-----------

SCR Airframe/Propulsion System Interactions

533 01 63	W81 70149
-----------	-----------

AIRPORT TOWERS**Wallop Flight Center Research Airport Support**

534-04 18	W81 70165
-----------	-----------

AIRPORTS**Wallop Flight Center Research Airport Support**

534-04 18	W81 70165
-----------	-----------

AIRSHIPS**Heavy Lift/Short Haul Hybrid Airship Technology**

505 42 51	W81 70086
-----------	-----------

Airborne Experiment Platforms

530-02 18	W81 70128
-----------	-----------

AIRSPED**Aviation Operations Safety Technology - Wind Shear and Collision Avoidance**

505 44-28	W81 70112
-----------	-----------

ALASKA**Alaska Wetlands Delineation Program**

677 21 22	W81 70412
-----------	-----------

ALGEBRA**Applied Mathematics**

505-31 83	W81-70015
-----------	-----------

ALGORITHMS**Theoretical Studies of Radar Backscatter**

677 41 11	W81-70422
-----------	-----------

Multispectral Linear Arrays for the Short Wave Infrared (MLA/SWIR)

677 77 01	W81 70438
-----------	-----------

Extended Atmospheres

154-80 80	W81 70475
-----------	-----------

Attitude/Orbit Systems Technology

310 10 26	W81 70573
-----------	-----------

RFI Systems Technology

310 30 69	W81 70588
-----------	-----------

ALL WEATHER AIR NAVIGATION**Rotorcraft Operating Systems Technology**

532 01-11	W81-70133
-----------	-----------

ALTIMETERS**Ocean Circulation and Topography**

146 40-07	W81 70337
-----------	-----------

Advanced Ocean Sensor Systems Development

146-40-13	W81 70339
-----------	-----------

Geopotential Field Models

676-40 01	W81 70404
-----------	-----------

ALUMINUM ALLOYS

Advanced Aluminum Alloys	W81 70032
--------------------------	-----------

ALUMINUM OXIDES

Composites for Propulsion Components	W81 70037
--------------------------------------	-----------

505-33 32 Materials Science	W81 70189
-----------------------------	-----------

AMINES

Aeronomy of Planetary Atmospheres	Chemistry
-----------------------------------	-----------

AMPLIFIERS

Electrophysics	W81 70472
----------------	-----------

AMPLIFIERS

506 54 42 Communications System Components	W81 70388
--	-----------

ANALOGS

Planetary Aeolian Processes on Planets	W81 70439
--	-----------

ANALOGIES

Mars Data Analysis Program	Geology
----------------------------	---------

ANALYSIS (MATHEMATICS)

Funds for Independent Research (Space)	W81 70244
--	-----------

ANEMOMETERS

Wind Alterations (Influence of Space Flight on the Blood Forming Tissues)	W81 70245
---	-----------

ANEMOMETERS

Blood Alterations (Influence of Space Flight on the Blood Forming Tissues)	W81 70539
--	-----------

ANEMOMETERS

Flight Meteorology Research Atmospheric Dynamics & Measurement Tech	W81 70105
---	-----------

ANGLE OF ATTACK

Aerodynamic Theory/Experimental Integration	W81 70007
---	-----------

ANGLE OF ATTACK

Flight Vehicle Dynamics	W81 70090
-------------------------	-----------

ANGLE OF ATTACK

SUBJECT INDEX**ATMOSPHERIC REFRACTION****ARCTIC REGIONS**

Crustal Modeling Using Satellite Potential Field Data
677 45-01
WB1 70429

ARIEL 5 SATELLITE

X-Ray Astronomy Data Analysis
389 46-04
WB1 70564

ARRAYS

Infrared Detectors Far IR Sensors
506 61-31
WB1 70253

ARTIFICIAL INTELLIGENCE

Automated Decision Making and Problem Solving
506-54-73
WB1-70219

Automation of Space Mission Uplink Process Control
506 54 75
WB1-70220

Autonomous Process Control Technology for Earth Orbital
Missions
506 54-76
WB1-70221

Intelligent Systems Research
506 54-83
WB1-70222

Robotics/Machine Intelligence Automated Systems
506-54 85
WB1-70223

Space Applications of Automation Robotics and Machine
Intelligence Systems (ARAMIS)
540 02-19
WB1-70283

Man-Machine Systems
199-60-60
WB1-70543

Human To-Machine Interface Technology
310-40-37
WB1 70591

ASSESSMENTS

Communications Satellite Applications Systems
643 10 02
WB1 70378

ASTEROIDS

Planetary Geology
151-01 70
WB1 70440

Planetary Dynamics
153-05 70
WB1 70450

Mars Data Analysis Astronomy
155 41 80
WB1 70482

Ground-Based Optical Planetary Astronomy
196 41 80
WB1 70529

ASTRODYNAMICS

Planetary Dynamics
153 05-70
WB1 70450

Dynamic Radiative Interaction
154 20 80
WB1 70461

ASTROMETRY

Detection of Other Planetary Systems
196 41 68
WB1 70524

ASTRONAUT PERFORMANCE

Space Motion Sickness
199 20-00
WB1-70538

ASTROAUTS

Medical Selection Criteria (Medical Evaluation and
Development of Standards for Space Crew Selection)
199 10-20
WB1 70535

ASTRONOMICAL MODELS

Experiment Development Laboratory and Theoretical
Solar Physics
170 38-53
WB1-70499

UV and Optical Astronomy
188 41-51
WB1-70502

Theoretical Studies of Galaxies Active Galactic Nuclei
and Quasi Stellar Objects
188-41 51
WB1 70503

ASTRONOMICAL OBSERVATORIES

UV and Optical Astronomy
188 41-51
WB1-70502

Ground Based Optical Planetary Astronomy
196-41 80
WB1 70529

ASTRONOMICAL PHOTOGRAPHY

Quantum Electronics Devices and Sensors
506-54 43
WB1 70209

Astronomical Optical Instrument Development
196-41 81
WB1 70530

Extreme Ultraviolet Explorer
685-20 06
WB1 70565

ASTRONOMICAL PHOTOMETRY

Sounding Rockets Experiments (Astronomy)
879 11 41
WB1 70571

ASTRONOMICAL SPECTROSCOPY

Multi-Spectral Detectors and Sensors
506-54 46
WB1 70211

Cosmic Chemistry Asteronomy Comets Grains
154 75 80
WB1 70471

Infrared and Radio Astronomy
188 41 55
WB1 70505

Optical Astronomy
196 41 71
WB1 70525

Theoretical Planetary Astronomy
196 41-85
WB1 70533

ASTRONOMICAL TELESCOPES

Advanced Mission Studies
188 78 60
WB1 70517

Astronomical Optical Instrument Development
196 41 81
WB1 70530

Extreme Ultraviolet Explorer
685 20-06
WB1 70565

ASTRONOMY

Signal Detection and Processing Filters and Receivers
506 54-56
WB1-70213

Fund for Independent Research
506 56-16
WB1-70247

UV and Optical Astronomy
188 41-51
WB1-70501

ATMOSPHERIC CIRCULATION

Fiber-Optically Mosaiced Large Area Image Sensors
188-41-54
WB1-70504

Laboratory Supporting Studies (Astronomy)
196-41 84
WB1-70531

Theoretical Planetary Astronomy
196-41 85
WB1-70533

ATMOSPHERICS

Fund for Independent Research
506-56 18
WB1-70247

UV and Optical Astronomy
188 41 51
WB1 70502

Theoretical Studies of Galaxies Active Galactic Nuclei
and Quasi Stellar Objects
188 41 51
WB1-70503

Theoretical Infrared and Radio Astrophysics
188 41 55
WB1 70506

Interdisciplinary Space Science Research
188 48 51
WB1 70514

Advanced Mission Studies
188 78 60
WB1 70517

Ground-Based Optical Planetary Astronomy
196 41 80
WB1 70529

Theoretical Planetary Astronomy
196 41 85
WB1 70533

Spacelab Science Payload Definitions ATD General
358 78-01
WB1 70552

High Energy Astrophysics Data Analysis
389 46 01
WB1 70562

Theoretical High Energy Astrophysics
389 46-03
WB1 70563

ATMOSPHERIC BOUNDARY LAYER

Aviation Meteorology Research - Basic Atmospheric
Processes
505 44-19
WB1 70106

Airborne Water Vapor Lidar
146-30-03
WB1-70332

Mars Data Analysis
155 04-80
WB1 70478

ATMOSPHERIC CHEMISTRY

Global Tropospheric Models Monitoring
146-20-08
WB1 70327

Ozone Data Reduction and Analysis and Solar UV
Variability
146-60-01
WB1-70346

Stratospheric Measurement Program Activities
146-60-01
WB1-70347

Upper Atmosphere Research Field Measurements
147-10 01
WB1 70352

In Situ Measurements of Stratospheric Ozone and Total
Chlorine
147-10 01
WB1 70353

Stratospheric Research Field Measurements Program
147-10 02
WB1-70354

Upper Atmosphere Research - Laboratory
Measurements
147 20 01
WB1 70357

Chemical Kinetics
147-20 01
WB1-70358

Quantitative Infrared Spectroscopy of Minor Constituents
of the Earth's Stratosphere
147 20 03
WB1 70359

Upper Atmosphere Research Theoretical Studies
147 30 01
WB1 70360

Stratospheric Theoretical Studies and Science Definition
Activities
147 30 01
WB1 70361

Photochemical Modeling of Trace Species in the
Stratosphere and Mesosphere
147 30 01
WB1 70362

Stratospheric Research
147 30 02
WB1 70363

Upper Atmosphere Research Satellites (UARS) Definition
Study
147 40-01
WB1 70365

Planetary Aeronomy Theory and Analysis
154 60-80
WB1 70467

Cosmic Chemistry Aeronomy Comets Grains
154 75-80
WB1 70471

Aeronomy of Planetary Atmospheres Chemistry
154 75 80
WB1 70472

ATMOSPHERIC CIRCULATION

Aerosol Climatic Effects Special Study
146 10-04
WB1 70325

Global Weather Research
146 30-02
WB1 70331

Airborne Water Vapor Lidar
146 30 03
WB1 70332

Planetary Atmospheric Dynamics
154-20-80
WB1 70459

Dynamics of Planetary Atmospheres
154-20-80
WB1-70460

Atmospheric Experiment Development
154-90 80
WB1-70476

Mars Data Analysis
155-04-80
WB1 70478

Planetary Atmospheres Data Analysis
155-04-80
WB1-70479

ATMOSPHERIC COMPOSITION

Remote Sensing Systems
506-61 35
WB1-70255

Stratospheric Measurement Program Activities
146-60 01
WB1-70347

Environmental Monitoring Research Satellite Mission
Studies
146-60 02
WB1-70349

ATMOSPHERIC MOISTURE

Stratospheric Research Field Measurements Program
147-10-02
WB1-70354

Atmospheric Processes Experiments and Systems
147-10-03
WB1-70356

Laser Heterodyne Spectrometer (LHS) Brassboard
147-40 01
WB1-70366

Planetary Aeolian Processes on Planets
151-01-60
WB1 70439

Planetary Atmospheric Composition and Structure
154-10-80
WB1-70457

Atomic & Molecular Properties of Planetary Atmospheric
Constituents
154-50 80
WB1-70465

Atomic and Molecular Properties
154 50 80
WB1-70466

Ultraviolet Spectroscopy of Planetary Atoms and
Molecules
154 70-80
WB1 70469

Planetary Atmospheres Data Analysis
155-04 80
WB1 70479

Theoretical Planetary Astronomy
196-41-85
WB1-70533

ATMOSPHERIC EFFECTS

Planetary Atmospheres Composition and Structure
154 10 80
WB1-70458

ATMOSPHERIC ELECTRICITY

Aviation Meteorology Research Basic Atmospheric
Processes
505 44 19
WB1-70106

Severe Storms and Local Weather Research
146-50-02
WB1 70345

ATMOSPHERIC ENTRY

Planetary Probe Aerothermodynamic Technology
506 51 21
WB1 70175

Planetary Probe Technology
506-51 23
WB1-70176

OEX Flight Data Analysis
506-51-31
WB1 70177

Aerodynamic/Aerothermodynamic Flight Data Analysis
506 51 33
WB1 70178

Thermal Protection Systems Materials and Systems
Evaluation
506-53 31
WB1-70195

ATMOSPHERIC MODELS

Numerical Climate Modeling
146-10 02
WB1 70323

Climate Research
146-10 03
WB1 70324

Aerosol Climatic Effects Special Study
146 10 04
WB1-70325

Global Tropospheric Models Monitoring
146-20 08
WB1 70327

Application of Remote Measurement Techniques to
Tropospheric Air Quality Monitoring
146-20 10
WB1 70328

Global Weather Research
146 30 02
WB1 70331

Upper Atmosphere Research Laboratory
Measurements
147-20 01
WB1 70357

Upper Atmosphere Research Theoretical Studies
147-30 01
WB1 70360

Photochemical Modeling of Trace Species in the
Stratosphere and Mesosphere
147 30-01
WB1 70362

Stratospheric Research
147 30-02
WB1-70363

Stratospheric Modeling
147 30 02
WB1-70364

Laser/VLBI Propagation Medium Analysis
676 59 35
WB1 70407

Planetary Atmospheres Composition and Structure
154 10-80
WB1 70458

Planetary Clouds Particulates and Ices Clouds of
Venus
154 30-80
WB1-70462

Extended Atmospheres
154-80 80
WB1 70475

Atmospheric Experiment Development
154-90 80
WB1 70476

Planetary Atmospheres Data Analysis
155-04-80
WB1-70479

ATMOSPHERIC MOISTURE

Airborne Water Vapor Lidar
146-30 03
WB1-70332

ATMOSPHERIC PHYSICS

Global Weather Research
146-30 02
WB1 70331

Atmospheric Lidar System Definition
146-60 03
WB1 70350

Upper Atmosphere Research - Field Measurements
147-10-01
WB1-70352

Upper Atmosphere Research - Theoretical Studies
147-30 01
WB1 70360

ATMOSPHERIC PRESSURE

Planetary Aeolian Processes on Planets
151 01 60
WB1 70439

ATMOSPHERIC RADIATION

Stratospheric Modeling
147-30-02
WB1-70364

ATMOSPHERIC REFRACTION

Laser/VLBI Propagation Medium Analysis
676 59 35
WB1 70407

Planetary Atmospheres Composition and Structure
676 59-37
WB1 70408

ATMOSPHERIC TEMPERATURE

Commercial Aircraft Fuel Savings
505 44-32
Dynamics of Planetary Atmospheres
154 20-80

W81 70115
W81 70460

ATMOSPHERIC TIDES

Mars Data Analysis
155-04-80

W81 70478

ATMOSPHERIC TURBULENCE

Aviation Meteorology Research Severe Storms
505 44 13
Knowledge of High Altitude Atmospheric Processes
505-44 14
Severe Storms and Local Weather Research
146 50 02
Dynamic Radiative Interaction
154 20 80

W81 70102
W81-70103
W81 70344
W81 70461

ATMOSPHERICS

Fund for Independent Research
506 56 16
Planetary Atmospheric Dynamics
154 20-80

W81 70247
W81 70459

ATOMIC BEAMS

Planetary Atmosphere Experiment Development
154-90-80

W81 70477

ATOMIC CLOCKS

Shuttle Time and Frequency Transfer Experiment (STIFT)
676-59 41
Precision Time and Frequency Sources
310-10 42

W81 70409
W81 70574

ATOMIC COLLISIONS

Experiment Development Laboratory and Theoretical
Solar Physics
170 38 53

W81 70499

ATOMIC SPECTRA

Ultraviolet Spectroscopy of Planetary Atoms and
Molecules
154 70 80

W81 70469

ATOMIC STRUCTURE

Atomic and Molecular Properties
154 50 80

W81-70466

ATTITUDE CONTROL

Advanced Spacecraft Pointing and Control Systems
506 54-93

W81 70224
Precision Pointing and Control Technology (PPACT)
Development

506-54-95
Electro Propulsion Technology
506-55-22

W81 70225
W81 70230

Earth Orbital Platform Systems Auxiliary Electric
Propulsion for Spacecraft Systems
506 62 62

W81 70266
Attitude/Orbit Systems Technology

310-10 26

W81 70573

AURORAS

Particle and Particle Field Interactions
170 36 55

W81 70490
Particle and Particle/Photon
(Atmospheric Magnetospheric Coupling)

170 36 56

W81 70493

AUSTRALIA

NASA/Geosat Test Case Study
677 41-02

W81 70418

AUTOMATA THEORY

Automated Decision Making and Problem Solving
506 54-73

W81 70219
Automation of Space Mission Uplink Process Control

506-54-75

W81 70220

Intelligent Systems Research
506-54-83

W81 70222
Robotics/Machine Intelligence Automated Systems

506-54-85

W81 70223

AUTOMATIC CONTROL

Aircraft Controls Electromechanical Actuator
Technology
505-34-37

W81 70053
Flight Management Systems

505-35 21
Automation of Space Mission Uplink Process Control
506-54 75

W81 70220
Advanced Spacecraft Pointing and Control Systems

506-54 93
Station Monitor and Control Technology
310-30 68

W81 70224
W81 70587

AUTOMATIC FLIGHT CONTROL

Aircraft Controls Theory and Techniques
505 34 33

W81 70051
Integration and Interfacing Technology

505 34 43
Integrated Avionic Control Systems for Rotorcraft
505 42-31

W81 70085
Interagency and Industrial Assistance and Testing

505 43-31
Advanced Guidance and Control Systems Validation
Technology

512 54-11
W81 70124

AUTOMATION
Space Applications of Automation Robotics and Machine
Intelligence Systems (ARAMIS)

540-02-19
W81-70283

AUXILIARY PROPULSION

Electric Propulsion Technology
506-55-22

W81-70230

AVIONICS

Cockpit Avionics Generic
505 34 23
Integration and Interfacing Technology
505 34-43
General Aviation Avionics and Control Technology
505 41-63

General Aviation Avionics and Controls
505 41 68

General Aviation Single Pilot IFR Systems
505-41 73

Remotely Piloted Research Aircraft Technology
505-43 44

Long Haul Transport Aircraft Systems Studies
530-04 13

General Aviation Advanced Avionics Systems
531-01 11

Rotorcraft Operating Systems Technology
532-01 11

Quiet Propulsive Lift Technology Experiments Aircraft
Performance and Operating Systems Research
532 02 11

Terminal Configured Vehicle Program
534 04-13

W81 70048
W81 70054
W81 70077
W81 70078
W81 70079
W81 70099
W81 70130
W81 70132
W81 70133
W81 70134
W81 70164

AXIAL FLOW TURBINES

Fan Compressor and Turbine Research
505 32 22

W81-70022

B**B-52 AIRCRAFT**

Intelligence Assistance and Testing
505-43 34

Aircraft Operational Support
505 43 54

W81 70098
W81 70100

BACKGROUND RADIATION

Cosmic Background Explorer (COBE)
685 20-08

W81 70566

BACKSCATTERING

Aviation Operations Safety Technology Applied Laser
Technology
505 44 29

W81-70113

Remotely Sensed Electromagnetic Characteristics of
Snow and Soil Moisture
677 22 12

Radar Spectrometer
677 27 04

Theoretical Studies of Radar Backscatter
677 41 11

Extended Scene Radar Calibration
677-47 02

W81 70433

BALLISTICS

NASA Ames Research Center Vertical Gun Facility
153-08 60

W81 70455

BALLOON FLIGHT

Airborne Experiment Platforms
530-02 18

Space Calibration of Solar Cells
542 03 20

W81 70292

Particle Astrophysics
188 46-56

W81 70508

Gamma Ray Astronomy
188 46 57

W81 70510

BALLOON-BORNE INSTRUMENTS

Aviation Meteorology Research Atmospheric Dynamics
& Measurement Tech
505 44-18

W81 70105

Improved Measurement and Calibration Techniques for
Stratospheric Trace Species
146 60-01

W81-70348

In-Situ Measurements of Stratospheric Ozone and Total
Chlorine
147 10-01

W81-70353

Evaluation of Advanced Sensor Concepts for Satellite
Monitoring of the Stratosphere
147 10-02

W81-70355

Atmospheric Processes Experiments and Systems
147 10-03

W81-70356

Laser Heterodyne Spectrometer (LHS) Brassboard
147 40-01

W81-70366

Infrared and Radio Astronomy
188 41-55

W81-70505

BANDPASS FILTERS

Radio Systems Development
310 20 66

W81-70585

BANDWIDTH

Advanced Synthetic Aperture Radar Technology
506 61 37

W81-70257

Communication Satellite Application Systems
643-10 02

W81 70377

BAYS (STRUCTURAL UNITS)

Aircraft Fire Safety and Testing
505 44 27

W81 70111

BEAM RIDER GUIDANCE

High Speed Data Transfer X/S Band Components
506 61 25

W81 70251

BEAMS (RADIATION)

30/20 GHz Spacecraft Multibeam Antenna Technology
650 60 20

W81 70386

BEAMS (SUPPORTS)

Large Space Structure System Engineering
906-55 00

W81 70598

BEARINGS

Power Transfer Research
505-32-42

Helicopter Transmission Technology
511-58 12

Sensor Cooling System
506-61 46

BELL AIRCRAFT

Aircraft Operational Support
505-43 54

W81 70100

BIOCHEMISTRY

Blood Alterations (Influence of Space Flight on the
Blood Forming Tissues)
199 20 50

Fluid and Electrolyte Change
199 20 60

W81-70540

BIOGEOCHEMISTRY

Geobotanical Test Site Investigations
677 42-01

W81 70424

BIOLOGICAL EFFECTS

Space Motion Sickness
199-20 00

W81 70538

BIMASS

Studies in Bioenergy
776-91 35

W81 70301

BIMASS ENERGY PRODUCTION

Studies in Bioenergy
776-91 35

W81 70301

BIOMEDICAL DATA

Systems Habitability Verification
199-10 41

Interdisciplinary Research
199 90 71

W81 70547

BIOSPHERE

Global Terrestrial Ecology
199 70 31

W81 70546

BIOTECHNOLOGY

Advanced Teleoperation Studies
199-60-80

W81 70545

BLACK HOLES (ASTRONOMY)

X-Ray Astronomy Time Variability and Polarimetry
188 46 59

X-Ray Astronomy
188 46-59

W81 70513

BLADDER

Prosthetic Urinary Sphincter Control Valving System
141 95 02

W81 70320

BLOOD

Bioseparation
179 80 80

W81 70374

Blood Alterations (Influence of Space Flight on the
Blood Forming Tissues)
199-20 50

W81 70539

BLOWOUTS

Aircraft Systems Operational Safety and Efficiency
Improvement
505-44 31

W81 70114

BODY CENTERED CUBIC LATTICES

Experimental Magnetism
153-08 50

W81 70454

BODY FLUIDS

Fluid and Electrolyte Change
199 20 60

W81 70540

BODY WING AND TAIL CONFIGURATIONS

Aerodynamic Theory/Experimental Integration
505 31 41

W81-70007

BOEING 737 AIRCRAFT

Terminal Configured Vehicle Program
534 04 13

W81 70164

BOUNDARY LAYER CONTROL

Turbulent Drag Reduction
505 31 23

W81-70004

Laminar Flow Control (Leading Edge Glove) - Flight
Research
534 01 14

W81 70158

BOUNDARY LAYERS

Computational Fluid Dynamics
505-31 13

W81 70002

Turbulence and Modeling
505 31 21

W81 70003

Microscale Ocean Surface Dynamics
146-40 05

W81 70333

BRAKES (FOR ARRESTING MOTION)

Aircraft Landing Systems Efficiency Improvements
505-44-33

W81 70116

BRAYTON CYCLE

Thermal-Electric and Thermionic Energy Conversion
Technology
506 55 65

W81 70239

BREADBOARD MODELS

Orbital Energy Storage and Power Systems (H2/O2)
506 55 57

W81 70238

Planetary Power Systems R & T
506 55 75

W81 70241

Multi KW Low Cost Earth Orbital Systems
506 55 79

W81 70243

Acoustic Containerless Experiment System (ACES)
179 70 10

W81 70370

30/20 GHz Spacecraft Multibeam Antenna Technology
650 60-20

W81 70386

SUBJECT INDEX

CLIMATOLOGY		
COMMUNICATIONS		
Communications Systems Breadboard		
650 60-23	W81 70389	High Spectral Resolution Remote Sensing
Advanced Teleoperation Studies	W81-70545	677-41 08 W81-70420
199-60-80		CATALOGS (PUBLICATIONS)
BROADCASTING		Applications Data Service (ADS) Atmospheric Pilot
Technical Consultation Services		System
643-10-01	W81-70375	656-13 30 W81-70393
Technical Consultation Services		CATALYSIS
643-10-01	W81-70376	OEX Flight Data Analysis
BUBBLE MEMORY DEVICES		506-51 31 W81-70177
Advanced Electronic Components		Combustion Technology for Power Generation
506 54-63	W81 70216	778-45 12 W81-70304
BUBBLES		CATALYSTS
Fusion Target Technology Study		Surface Physics and Computational Chemistry
179-20-57	W81-70369	506-53 11 W81-70188
Glass Research		CATHODES
179-80 30	W81-70373	Advanced Nickel-Cadmium and Lithium Batteries
BUDGETING		506-55 55 W81-70237
Data Reproduction in Support of the Mars Data Analysis		CEILINGS (METEOROLOGY)
Program		Aviation Meteorology Research Atmospheric Dynamics
155 50 01	W81-70484	& Measurement Tech
		505 44 18 W81 70105
C		
C BAND		CELESTIAL MECHANICS
Satellite Communications Technology		Planetary Dynamics
310-20 38	W81-70581	153 05 70 W81 70450
C-135 AIRCRAFT		CELLS (BIOLOGY)
Energy Efficient Transport Flight Research		Bioseparation
534-02 14	W81 70161	179 80 80 W81 70374
C-47 AIRCRAFT		CENTRAL PROCESSING UNITS
Aircraft Operational Support		Synthetic Aperture Radar Processor
505-43 54	W81 70 00	656 62 01 W81 70400
CABLES (ROPE)		CH-47 HELICOPTER
Systems for Underwater Survey and Exploration		Rotocraft Aerodynamic Performance Dynamics and
(SUSE)		Handling Qualities
637-01 02	W81 70381	505 42-21 W81 70083
CADIUM		CHANNELS (DATA TRANSMISSION)
Electrochemical Energy Conversion and Storage		Flight Research Instrumentation Development
506-55-52	W81 70236	505 31-54 W81 70012
CALIBRATING		Integration and Interfacing Technology
Space Calibration of Solar Cells		505-34-43 W81 70054
542 03-20	W81 70292	High Speed Data Transfer S/K Band Components and
Laser/VLBI Propagation Medium Analysis		Techniques
676-59-37	W81 70408	506-61-26 W81-70252
Remotely Sensed Electromagnetic Characteristics of		Remote Sensing Frequency Coordination Studies
Snow and Soil Moisture		643-10-04 W81 70380
677 22-12	W81 70413	Network Systems Technology Development
Extended Scene Radar Calibration		310-20-33 W81-70580
677 47-02	W81 70433	CHARGE COUPLED DEVICES
Multispectral Linear Arrays for the Short-Wave Infrared		Advanced Electronic Components
(MLA/SWIR)		506-54 63 W81-70216
677 77-01	W81 70438	Advanced CCD Camera Development
Experimental Magnetism		157-01 01 W81-70486
153 08-50	W81 70454	Planetary Infrared Imaging
Particle Accelerator Facility Maintenance and Operation		196-41 77 W81-70527
of a Calibration Facility for Magnetospheric and		CHARGE TRANSFER
Solar-Terrestrial Experiments		Quantum Electronics Sources
170 36 57	W81 70494	506-54 45 W81-70210
CALLISTO		CHARGED PARTICLES
Extended Atmospheres		Planetary Power Systems R & T
154 80 80	W81 70475	506-55 75 W81-70241
CALORIMETERS		Magnetospheric Data Analysis
Aerodynamic/Aerothermodynamic Flight Data Analysis		385-36 01 W81-70555
506 51 33	W81 70178	CHECKOUT
CAMERAS		Advanced Guidance and Control Systems Validation
Advanced CCD Camera Development		Technology
157 01 01	W81 70486	512 54 11 W81-70124
Astronomical Optical Instrument Development		CHEMICAL ANALYSIS
196 41 81	W81 70530	Instrument Development for Spaceflight Experiments
CANARD CONFIGURATIONS		157 03 40 W81-70488
High Performance Aircraft Airframe Propulsion		Infrared Astronomy
Integration		196 41 72 W81 70526
505-43 21	W81-70093	CHEMICAL CLOUDS
CAPACITORS		Space Plasma Physics
Signal Processing and Detection High-Density Circuit		356 36 01 W81 70548
Technology		CHEMICAL COMPOSITION
506-54-59	W81-70214	Stratospheric Research
CAPILLARY WAVES		147 30 02 W81 70363
Spacelab 2 Superfluid Helium Experiment		Planetary Materials Lunar Sample Analysis
542-03 13	W81-70291	152 01 40 W81 70442
CARBON DIOXIDE		Planetary Materials Laboratory and Analytical Studies
Aeronomy of Planetary Atmospheres Chemistry		152 02 40 W81 70443
154-75-80	W81 70472	Particle Astrophysics and Shuttle Experiment Definition
Aeronomy Chemistry		188 46-56 W81 70509
154-75-80	W81 70473	Laboratory Supporting Studies (Astronomy)
CARBON FIBERS		196 41 84 W81 70531
Fire Resistant Materials		CHEMICAL PROPERTIES
505 33 31	W81 70036	Surface Physics and Computational Chemistry
Composites for Propulsion Components		506 53-11 W81 70188
505 33 32	W81 70037	Mars Data Analysis Program
CARBON MONOXIDE		155 20 40 W81 70480
Theoretical Studies of the Upper Tropospheric Aerosol		CHEMICAL PROPULSION
Layer and Sahara Dust		Liquid Chemical Propulsion Technology
146 20 23	W81 70329	506 52 12 W81 70180
Theoretical Infrared and Radio Astrophysics		High Energy Chemical Propulsion Technology for
188 41 55	W81 70506	Planetary Spacecraft
CARBON-CARBON COMPOSITES		506 52 25 W81-70183
Advanced Carbon Carbon Stand-Off Panel		Chemical Propulsion Research Support
506 53-37	W81 70197	506-52-30 W81-70184
CARBONATES		Advanced Chemical Propulsion Concepts For Planetary
Refining of Nonterrestrial Materials		Spacecraft
506 53-17	W81 70191	506-52 35 W81-70185
		Space Propulsion and Power System Studies
		540-02-12 W81-70281
CLIMATOLOGY		
CHEMICAL REACTIONS		Fundamentals of Mechanical Behavior of Composites
		Matrices
		506-53 15 W81-70190
		Upper Atmosphere Research - Laboratory
		Measurements
		147-20 01 W81 70357
CHEMISTRY		Funds for Independent Research (Space)
		506-56 11 W81 70244
		Fund for Independent Research (Space)
		506-56 12 W81 70245
CHIPS (ELECTRONICS)		Advanced CCD Camera Development
		157-01 01 W81 70486
CHLORINE		In Situ Measurements of Stratospheric Ozone and Total
		Chlorine
		147-10-01 W81-70353
CHLORINE OXIDES		Photochemical Modeling of Trace Species in the
		Stratosphere and Mesosphere
		147 30-01 W81-70362
CHLOROPHYLLS		Coastal and Estuarine Dynamic Processes Research
		146 40-15 W81 70342
		Great Lakes Water Quality Research
		146 40-18 W81-70343
CHROMOSPHERE		Development of Solar Spacelab Experiment and
		Hardware
		170-38-51 W81-70496
		Experiment Development Laboratory and Theoretical
		Solar Physics
		170-38-53 W81-70499
		Advanced Mission Study Solar X-Ray Pinhole Satellite
		and Long Focal Length Coronagraph
		356-38-01 W81-70549
CHRONOPHOTOGRAPHY		CHRONOPHOTOGRAPHY
		Dynamic Radiative Interaction
		154-20 80 W81 70461
CIRCUITS		CIRCUITS
		High Density Circuit Technology Electronic Devices
		506-54-60 W81-70215
		Multi KW Low Cost Earth Orbital Systems
		506-55-79 W81-70243
		High Efficiency Technology for Microwave Amplifiers
		506-61 22 W81-70250
CITIES		CITIES
		Application of Remote Measurement Techniques to
		Tropospheric Air Quality Monitoring
		146-20 10 W81 70328
CIVIL AVIATION		CIVIL AVIATION
		Cockpit Avionics Generic
		505 34 23 W81 70048
		Crew Interaction with Advanced Flight Systems
		505-35 23 W81 70057
		General Aviation System Technology Studies
		530 01 13 W81 70126
		Propulsion Systems for Small Transports
		530 04 12 W81 70129
		General Aviation Advanced Avionics Systems
		531 01 11 W81 70132
		Quiet Propulsive Lift Technology Experiments Aircraft
		Performance and Operating Systems Research
		532 02 11 W81 70134
		Advanced Rotor Systems Technology/RSRA
		Operations
		532 03 11 W81 70136
		Tilt Rotor Research Aircraft Flight Investigations
		532 04 11 W81 70137
CLAYS		CLAYS
		High Spectral Resolution Remote Sensing
		677-41-08 W81 70420
CLEAR AIR TURBULENCE		CLEAR AIR TURBULENCE
		Microwave Technology Development for Atmospheric
		Turbulence Studies
		505 44 15 W81-70104
		Aviation Operations Safety Technology Applied Laser
		Technology
		505 44-29 W81-70113
CLIMATE		CLIMATE
		Numerical Climate Modeling
		146-10 02 W81-70323
		Aerosol Climatic Effects Special Study
		146-10-04 W81-70325
		Stratospheric Modeling
		147-30-02 W81-70364
		Upper Atmosphere Research Satellites (UARS) Definition
		Study
		147-40-01 W81-70365
CLIMATOLOGY		CLIMATOLOGY
		Climate Research
		146-10-03 W81-70324
		Aerosol Climatic Effects Special Study
		146-10-04 W81-70325
		Ozone Data Reduction and Analysis and Solar UV
		Varability
		146-60-01 W81 70346
		Applications Data Service (ADS) Atmospheric Pilot
		System
		656-13 30 W81-70393
		Magnetospheric Physics Particles and Particle/Field
		Interaction
		170-36-55 W81 70491

CLINICAL MEDICINE

Operational Laboratory Support
199-10-10 W81 70534
Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection)
199-10-20 W81-70535

CLOCKS

Utilization of Space for Science Experiments
506-56-29 W81-70249
Network Timing and Synchronization Technology
310-20-27 W81 70579

CLOSED CIRCUIT TELEVISION

Commercial Prototype Fusion-Welding System (Computer Controlled/Closed Circuit Television Arc Guidance)
141-95-01 W81-70318

CLOUD COVER

Radiation Budget and Aerosol Studies
146-10-06 W81-70326

CLOUD PHYSICS

Severe Storms and Local Weather Research
146 50-02 W81-70345

Electrostatic Control & Manipulation of Materials for Containerless Processing
179 20-56 W81-70368

Planetary Clouds Particulates and Ices Clouds of Venus
154 30 80 W81 70462

Clouds Particulates and Ices
154 30-80 W81 70463

CLOUDS

Radiative Transfer in Cloudy Atmosphere
154 40-80 W81 70464

CLOUDS (METEOROLOGY)

Climate Research
146 10-03 W81 70324

Severe Storms and Local Weather Research
146 50-02 W81-70344

COAL GASIFICATION

Coal Conversion Processes and Systems
778 47-29 W81-70310

Advanced Energy Technology for Utilities
778 50-29 W81-70315

COAL LIQUEFACTION

Advanced Coal Processing Concepts
778-47-15 W81-70309

Coal Conversion Processes and Systems
778 47-29 W81 70310

Advanced Energy Technology for Utilities
778-50-29 W81 70315

COAL UTILIZATION

Advanced Coal Processing Concepts
778-47 15 W81 70309

Coal Conversion Processes and Systems
778 47 29 W81 70310

Advanced Energy Technology for Utilities
778 50 29 W81 70315

COASTAL ECOLOGY

Coastal and Estuarine Dynamic Processes Research
146 40-15 W81 70341

COASTAL PLAINS

Advanced Ocean Sensor Systems Development
146 40 13 W81 70340

COASTAL WATER

Great Lakes Water Quality Research
146-40-18 W81 70343

COCKPITS

Cockpit Avionics Generic
505-34-23 W81 70048

Flight Management Systems
505-35-21 W81 70056

CODING

Computational and Experimental Aerothermodynamics
506-51-11 W81 70173

Telemetry Technology Development
310 20 67 W81 70586

COGENERATION

Power Generation Concepts and Applications
778-46-12 W81 70306

Stirling Engine Components and System Concepts
778 46-22 W81 70307

Validation of Stirling Lab Engine
778-46-35 W81 70308

COGNITION

Man-Machine Systems
199-60-60 W81 70543

Advanced Teleoperation Studies
199-60 80 W81 70545

COHERENT LIGHT

Aviation Operations Safety Technology Applied Laser
Technology
505 44 29 W81 70113

COLLISION AVOIDANCE

Aviation Operations Safety Technology Wind Shear and
Collision Avoidance
505 44 28 W81 70112

COLLISIONLESS PLASMAS

Particle and Particle/Photon Interactions
(Atmospheric-Magnetospheric Coupling)
170 36-56 W81 70493

COLORIMETRY

Coastal and Estuarine Dynamic Processes Research
146-40-15 W81 70342

COMBUSTION

Advanced Reusable Main Engine Technology
506-52-19 W81 70182
Photophysics and Laser Diagnostics
506-54-41 W81-70207
Combustion Technology for Power Generation
778-45-12 W81 70304

COMBUSTION CHAMBERS

Combustion and Emissions Reduction Research
505 32-32 W81 70023

Hypersonic Propulsion Research
505 32 93 W81 70030

Turbine Engine Hot Section Technology (HOST)
510 51 12 W81 70120

Advanced Low Emission Combustor (ALEC)
511 55 12 W81 70121

Broad Property Fuels Technology
511 59 12 W81 70123

Advanced Reusable Main Engine Technology
506 52 19 W81 70182

COMBUSTION EFFICIENCY

Combustion and Emissions Reduction Research
505-32 32 W81 70023

Advanced Low Emission Combustor (ALEC)
511-55 12 W81 70121

COMBUSTION PRODUCTS

Combustion and Emissions Reduction Research
505 32 32 W81-70023

Advanced Low Emission Combustor (ALEC)
511 55-12 W81-70121

COMET HEADS

Imaging Studies of Comets
196-41 52 W81-70522

COMETS

Planetary Dynamics
153 05-70 W81-70450

Clouds Particulates and Ices
154 30-80 W81 70463

Aeronomy Theory and Analysis
154 60 80 W81 70468

Ultraviolet Spectroscopy of Planetary Atoms and
Molecules
154-70 80 W81 70469

Cosmic Chemistry Aeronomy Comets Grains
154-75 80 W81 70471

Aeronomy Chemistry
154-75 80 W81 70473

Instrument Definition
157-03 01 W81-70487

Instrument Development for Spaceflight Experiments
157-03 40 W81-70488

Cometary Observation and Theory
196 41 30 W81-70518

Imaging Studies of Comets
196 41 52 W81-70522

Ground-Based Optical Planetary Astronomy
196 41 80 W81 70529

COMMAND AND CONTROL

Mission Operations Technology
310 40-45 W81-70592

COMMERCIAL AIRCRAFT

Propulsion Systems for Small Transports
530 04 12 W81 70129

Laminar Flow Control
534-01 13 W81 70157

Laminar Flow Control (Leading Edge Glove) Flight
Research
534-01 14 W81 70158

Composite Components Technology
534 03 13 W81 70162

COMMUNICATION NETWORKS

ADS Oceanic Pilot System Project
656-13 40 W81 70394

Network Timing and Synchronization Technology
310-20 27 W81 70579

COMMUNICATION SATELLITES

Earth Satellite Communication Antenna Development
541-02 15 W81 70288

Technical Consultation Services
643-10-01 W81 70376

Communication Satellite Application Systems
643-10-02 W81 70377

Communications Satellite Applications Systems
643-10-02 W81 70378

Seafloor Automated Lander Technology (SALT) (Formerly
the High Energy Benthic Boundary Layer
Experiment- HEBBLE)
637-01-04 W81 70383

30/20 GHz Wideband System Definition
650-20-16 W81-70384

GHz Wideband Communications Satellite Project
Definition
650 60 18 W81 70385

30/20 GHz Spacecraft Multibeam Antenna Technology
650 60 20 W81 70386

Satellite Switching and Processing Systems
650 60 21 W81-70387

Communications System Components
650 60 22 W81 70388

Communications Systems Breadboard
650 60 23 W81-70389

Satellite Communications Technology
310 20-38 W81-70581

COMPOSITE MATERIALS

Life Prediction for Composite Materials
505 33 23

Composites for Propulsion Components
505 33 32

Low Speed Propeller Research
505 41-52

Materials for Advanced Turbine Engines (MATE)
510-53 12

Advanced Rotorcraft Systems Technology Materials and
Noise
532-06 13

Composite Components Technology
534-03-13

Large Composite Primary Aircraft Structures (LCPAS)
Key Technology
534-03 33

Fundamentals of Mechanical Behavior of Composites
Matrices
506 53-15

Composites for Advanced Space Systems
506 53-23

Effects of Space Environment on Composites
506 53-25

Failure and Thermal Analysis
506 53-53

Large Space Structures Systems Technology
506 62-43

Large Space Structure System Engineering
906-55-00 W81 70598

COMPOSITE STRUCTURES

Composites
505-33 33

Interdisciplinary Research in Composite Structures
505 33 60

Integrated Analysis and Synthesis
505 33 62

Aeronautical Structural Design Methods
505-33 63

Rotorcraft Structures Vibration Aeroelasticity and
Acoustics
505 42 13

SCR Materials and Structures
533 01 13

SCR Materials and Structures Flight Research
533 01 14

Composite Components Technology
534 03 13

Large Composite Primary Aircraft Structures (LCPAS)
Key Technology
534 03 33

COMPRESSOR ROTORS

Fan Compressor and Turbine Research
505 32 22

Fan Compressor and Turbine Research
505 32 22 W81-70022

COMPRESSORS

Fan Compressor and Turbine Research
505 32 22 W81-70022

Computational Fluid Mechanics for Turbomachinery
505 32 52

Graduate Research Program in Aeronautics
505-36 22

Aeroelasticity of Turbine Engines
510-55 12 W81-70067

COMPUTATIONAL FLUID DYNAMICS

Airfoil Development
505-31 33

Aerodynamic Theory/Experimental Integration
505-31 41

Computational Fluid Mechanics for Turbomachinery
505-32 52

CFD Training Program
505-36 20

Aeronautics Graduate Research Program FY 1981
505-36-21

Graduate Research Program in Aeronautics
505 36 22 W81 70067

Computational and Experimental Aerothermodynamics
506 51 11 W81 70173

COMPUTER GRAPHICS

Applied Mathematics
505-31 83

Loads Dynamics and Aeroelasticity
505-33-52

Simulation Technology for Aeronautics
505 35 31

Integrated Programs for Aerospace-Vehicle Design
(IPAD)
510 54 13

ADS Oceanic Pilot System Project
656-13 40 W81 70394

Data Analysis Astronomy
389 41 01

W81 70561

COMPUTER PROGRAMMING

Mission Operations Technology
310-40 45 W81-70592

COMPUTER PROGRAMS

Computational Fluid Dynamics
505-31 13

Aerodynamic Theory/Experimental Integration
505-31 41

Applied Mathematics
505-31 83

Inlet Nozzle and Propeller Research
505-32 12

SUBJECT INDEX**CRATERING**

Integrated Analysis and Synthesis	W81 70043	Rotorcraft Aerodynamics Scale Modeling	W81-70084	Curation of Extraterrestrial Samples	W81 70444
505 33 62		505-42 23		152-04-40	
Electronic Aircraft Engine Control	W81-70050	Heavy-Lift/Short Haul Hybrid Airship Technology	W81-70086	COSMIC PLASMA	
505 34 32		505-42-51		Particle and Particle Field Interactions	W81 70490
Integrated Avionic Control Systems for Rotorcraft	W81 70085	Numerical Aerodynamic Simulator (NAS Project)	W81-70172	170-36-55	
505 42 31		536-01 11		Particles and Particle/Field Interactions	W81-70492
Flight Dynamics and Handling Qualities	W81 70092	Surface Mine Rehabilitation Inventory and Monitoring	W81-70411	170-36-55	
505 43 14		677-21 20		Space Plasma Physics	W81-70492
Remotely Piloted Research Aircraft Technology	W81 70099	Terrain Models for SAR Development	W81-70425	356-36-01	W81-70548
505 43-44		677-43-01		Pioneer 6 11 Plasma Data Analysis	W81 70556
Integrated Programs for Aerospace Vehicle Design (IPAD)		Network Productivity Research	W81-70596	385-36 01	
510 54 13	WB1-70118	310-40-73		Data Analysis Space Plasma Physics	W81-70557
Advanced Guidance and Control Systems Validation				385-36-02	
Technology		505-43-31			W81-70557
512 54 11	WB1 70124	Robotics/Machine Intelligence Automated Systems	W81-70096	COSMIC RAYS	
Plume Characterization		506-54 85		Cosmic Chemistry Aeronomy Comets Grains	W81-70471
506 52 39	WB1 70186	CONTAINERLESS MELTS		154-75-80	
Optimization of Structural Systems		Advanced Containerless Processing Technology	W81-70367	Particle Astrophysics	
506 53 55	WB1 70201	179-20-55		188-46-56	W81-70508
Payload Environments and Dynamics	W81 70205	Electrostatic Control & Manipulation of Materials for Containerless Processing	W81-70367	Particle Astrophysics and Shuttle Experiment Definition	
506 53 66		179-20 56		188-46 56	W81 70509
Signal Processing and Detection	High Density Circuit	Acoustic Containerless Experiment System (ACES)	W81-70368	X-Ray Astronomy	
Technology		179-70-10		188-46 59	W81 70513
506 54 59	WB1 70214	W81-70370		Low Gravity Superfluid Helium Advanced Technology Development	
Planetary & Solar Spacecraft Systems	Automated Optical Navigation	W81-70370		188-78-51	W81-70515
506-62 55	WB1-70265	CONTROL		Advanced Mission Studies	
OSTA/ADS Data Systems Standards and Guidelines Program		Airfoil Development	W81-70006	188-78-60	W81 70517
656 13-10	WB1 70391	505-31 33		High Energy Astrophysics Data Analysis	
Automated Mosaicking for Geocoded Data Bases		CONTROL CONFIGURED VEHICLES		389-46 01	W81 70562
656-33 01	WB1-70398	Aeronautical Structural Design Methods	W81-70044	Theoretical High Energy Astrophysics	
Geopotential Field Models		505-33 63		389-46 03	W81-70563
676 40 01	WB1 70404	CONTROL SIMULATION		X-Ray Astronomy Data Analysis	
Software Engineering Technology		Aircraft Controls Theory and Techniques	W81-70051	389-46-04	W81 70564
310 10-23	WB1 70572	505-34-33		COSMOLOGY	
COMPUTER STORAGE DEVICES		General Aviation Aerodynamics and Handling Qualities	W81-70051	Cosmic Background Explorer (COBE)	
NASA End-to-End Data System (NEEDS) Data Base Management/Archival Mass Memory	W81 70263	Technology	685-20 08	W81 70566	
506 61 59		505-41 13		COST ANALYSIS	
COMPUTER SYSTEMS DESIGN		W81-70071		General Aviation Avionics and Control Technology	
Integrated Programs for Aerospace Vehicle Design (IPAD)		CONTROL SURFACES		505-41-63	W81 70077
510 54 13	WB1-70118	Laminar Flow Control (Leading Edge Glove)	W81-70158	Low Speed Aircraft Systems Studies	
NASA End to End Data System	Information Adaptive System	Flight Research	W81-70158	530-02-11	W81 70127
506 61 53	WB1 70260	534-01 14		Cost Analysis of Space Flight Systems within the Office for Space and Terrestrial Applications	
NASA End to End Data System		CONTROL THEORY		146-90 03	W81-70351
506 61 55	WB1 70261	Engine Dynamics and Controls Research	W81-70026	30/20 GHz Wideband System Definition	
NASA End to End Data System (NEEDS) Phase 2		Aircraft Controls Reliability Enhancement	W81-70049	650-20-16	W81 70384
506 61-56	WB1-70262	505-34-31		Extreme Ultraviolet Explorer	
NASA End to End Data System (NEEDS) Data Base Management/Archival Mass Memory		Electronic Aircraft Engine Control	W81-70049	685-20 06	W81 70565
506 61 59	WB1 70263	505-34 32		COST EFFECTIVENESS	
Information Systems for Earth Observations for Space		Intergeneracy and Industrial Assistance and Testing	W81-70096	Signal Processing and Detection High-Density Circuit	
540 01 13	WB1-70277	505-43 31		Technology	W81 70214
Space Mission Uplink Process Control Architecture		Advanced Guidance and Control	W81-70096	Shuttle Derived Vehicle Technology Requirements	
540 01 15	WB1 70278	Experiments	W81-70125	540-03-19	W81 70285
Software Engineering Technology		512-54 14		Space Calibration of Solar Cells	
310 10 23	WB1 70572	CONTROL VALVES		542-03 20	W81 70292
High Speed Signal Processing Research		Prosthetic Urinary Sphincter Control	W81-70320	Communication Satellite Application Systems	
310 30-70	WB1-70589	Valving System	W81-70320	643 10-02	W81 70377
Operations Support Computing Technology		CONTROLLABILITY		Applications Data Base Management System (ADBMS)	
310 40 26	WB1-70590	Aircraft Controls Theory and Techniques	W81-70051	656-31 02	W81 70397
Human-To-Machine Interface Technology		505-34-33		Antennae Systems Development	
310 40 37	WB1 70591	General Aviation Aerodynamics and Handling Qualities	W81-70051	310-20 65	W81 70584
COMPUTER SYSTEMS PROGRAMS		Technology	W81-70051	Network Productivity Research	
Applications Data Base Management System (ADBMS)	W81-70397	505-41 13		310 40 73	W81 70596
656 31 02		CONTROLLED ATMOSPHERES		COST ESTIMATES	
RFI Systems Technology		Systems Habitability Verification	W81-70537	Cost Analysis of Space Flight Systems within the Office for Space and Terrestrial Applications	
310 30 69	WB1-70588	199-10-41		146-90 03	W81 70351
Network Data Processing Development		CONTROLLERS		Full Scale Applications Data Service (ADS) Planning Studies	
310 40-72	WB1 70595	Aircraft Controls Reliability Enhancement	W81 70049	656-13 20	W81-70392
COMPUTER TECHNIQUES		505-34 31		Demonstration Flight System and Operational Land Observing System (DLOS)	
CFD Training Program		Electronic Aircraft Engine Control	W81-70050	677-29 06	W81 70416
505 36 20	WB1-70065	505-34 32		COST REDUCTION	
Fire Systems Full Scale Test		Instrument Definition	W81-70372	Advanced Rotorcraft Propulsion Technology	
534 05 17	WB1 70166	179-80 10		532 06-12	W81 70141
Software Engineering Technology		Infrared Detector Materials Preparation	W81 70372	Multi KW Low Cost Earth Orbital Systems	
310 10-23	WB1 70572	506-61 46		506-55 79	W81 70243
COMPUTERIZED DESIGN		COOLERS		COSTS	
Integrated Analysis and Synthesis	WB1 70043	Sensor Cooling System	W81-70259	Advanced Manned Vehicle Onboard Propulsion Technology	
505 33 62		506-61 46		506-52 17	W81 70181
Aeronautical Structural Design Methods	WB1 70044	COOLING		Systems Habitability Verification	
505 33-63		High Temperature Aeronautical Structures	W81 70046	199 10-41	W81 70537
Aircraft Controls Theory and Techniques	WB1-70051	Instrument Definition	W81-70487	COUPLING CIRCUITS	
505 34-33		505-33 73		Solid State Research Superconducting Circuitry	
General Aviation Aerodynamics and Handling Qualities Technology	WB1-70051	Fan Compressor and Turbine Research	W81-70022	506-54 69	W81 70218
505 41 13	WB1 70071	Sensor Cooling System	W81-70259	Fatigue Damage and Environmental Effects in Metals and Composites	
Integrated Programs for Aerospace Vehicle Design (IPAD)		506-61 46		505 33 21	W81 70033
510 54-13	WB1-70118	Aerodynamics of Ground Vehicles	W81-70316	CRACK INITIATION	
Computational Methods and Applications in Fluid Dynamics		141 20-11		Fatigue Damage and Environmental Effects in Metals and Composites	
505 31-11	WB1-70001	WB1-70406		505 33 21	W81 70033
Loads Dynamics and Aeroelasticity		COPOLYMERS		CRACK PROPAGATION	
505 33 52	WB1-70039	Fire Resistant Materials	W81-70036	Metallic/Ceramic Materials	
Application of Flight Simulation Technology		505-33-31		505 33 12	W81 70031
505 35 33	WB1-70060	COPPER		Surface Physics and Computational Chemistry	
General Aviation Crash Dynamics		NASA/Geosat Test Case Study	W81 70418	505-33-11	W81 70188
505 41-33	WB1 70074	677-41 02		CRASHES	
COMPUTERIZED SIMULATION		COSMIC BACKGROUND EXPLORER SATELLITE		General Aviation Crash Dynamics	
Computational Methods and Applications in Fluid Dynamics		Cosmic Background Explorer (COBE)	W81 70418	505-41 33	W81 70074
505 31-11		685-20-08		Aviation Operations Safety Technology	W81 70108
Loads Dynamics and Aeroelasticity		COSMIC DUST		CRATERING	
505 33 52		Planetary Materials	W81-70443	NASA Ames Research Center Vertical Gun Facility	
Application of Flight Simulation Technology		Laboratory and Analytical Studies	W81-70443	153 08 60	W81 70455
505 35 33		152-02 40			
General Aviation Crash Dynamics					
505 41-33					

CREEP PROPERTIES	Climate Research	W81 70324	Global Weather Research	
Life Prediction	146 10 03	W81 70324	146-30-02	
505 33-22	Stratospheric Measurement Program Activities		Cost Analysis of Space Flight Systems within the Office	
CROP GROWTH	146-60 01	W81 70347	for Space and Terrestrial Applications	
Aerial Applications Aerodynamics and Systems	OSTA Data Systems Standards and Guidelines		146 90-03	
Interaction	656 13 10	W81-70390	Systems for Underwater Survey and Exploration	
505-41-83	OSTA/ADS Data Systems Standards and Guidelines		(SUSE)	
CROSS CORRELATION	Program		637-01 02	
X Ray Astronomy Time Variability and Polarimetry	656-13 10	W81 70391	Automated Mosaicking for Geocoded Data Bases	
188-46-59	ADS Oceanic Pilot System Project		656-33 01	
CRUSTAL FRACTURES	656-13 40	W81 70394	Registration of Radar and Other Data	
Regional Crustal Deformation Modeling	Oceanic Data Utilization System Study		656 45-02	
676 10 10	Development		Synthetic Aperture Radar Processor	
CRYOGENIC COOLING	656 13 60	W81 70395	656 62-01	
Solid State Research Superconducting Circuitry	ADS Pilot Geosciences Information Network		Alaska Wetlands Delineation Program	
506 54 69	Development		677 21 22	
CRYOGENIC EQUIPMENT	656 13 70	W81 70396	Magsat Correlative Studies	
Thermal Control System Technology	Applications Data Base Management System (ADBMS)		677 45-04	
506 53 39	656 31 02	W81 70397	NASA Airborne Imaging Radar Facility	
Sensor Cooling System	Automated Mosaicking for Geocoded Data Bases		677 47-03	
506 61 46	656 33-01	W81 70398	Seasat Digital SAR Processing (Non Renewable	
Low Gravity Superfluid Helium Advanced Technology	Station Monitor and Control Technology		Resources)	
Development	310 30 68	W81 70587	677 48-01	
188 78 51		Very Low Cost Data System	16 Bit	
Radio Systems Development		Microprocessor Driven ELAS		
310 20-66		677 70 04	Remote Sensing	
CRYOGENIC FLUID STORAGE			153 07 40	
Cryogenic Fluid Management	Laser Heterodyne Spectrometer (LHS) Brassboard		Radar Studies	
542 03-52	147 40 01	W81 70366	153-07 70	
CRYOGENIC WIND TUNNELS	Infrared Detectors Far IR Sensors		Planetary Atmospheric Composition and Structure	
Experimental Methods and Instrumentation	506-61 31	W81 70253	154 10 80	
505-31-53	Stratospheric Measurement Program Activities		Planetary Atmospheres Composition and Structure	
Full Space Reynolds Number Test Technology	146-60 01	W81 70347	154-10 80	
505-31-63	Solar Physics Data Analysis and Operations		Advanced Technological Development General Signal	
CRYOGENICS	385 38 01	W81 70559	and Data Processing Electronics Solid State Detectors	
Spacelab 2 Superfluid Helium Experiment			188 78 51	
542 03-13			Solar Physics Data Analysis and Operations	
CRYSTAL GROWTH			385 38 01	
Solar Cell Research	Data Transmission and Processing Research		Data Analysis Solar Physics	
506 55 43	506-54 55	W81 70212	385-38 01	
Semiconductor Materials Growth in Low g	Automation of Space Mission Uplink Process Control		Data Analysis Astronomy	
Environment	506 54 75	W81 70220	389 41 01	
542 03 30	High Speed Data Transfer S/K Band Components and		High Energy Astrophysics Data Analysis	
Infrared Detector Materials Research	Techniques		389-46 01	
179 80 10	506 61 26	W81 70252	Theoretical High Energy Astrophysics	
Infrared Detector Materials Preparation	Satellite Communications Technology		389-46 03	
179-80 10	541 02 12	W81 70287	Navigation Technology Development	
	Network Systems Technology Development		310 10 63	
	310 20 33	W81 70580	Telemetry Technology Development	
CRYSTALLIZATION			310 20 67	
Glass Research	DATA MANAGEMENT		RFI Systems Technology	
179 80 30	Applied Mathematics	506 31 83	310 30 69	
	NASA End-to-End Data System	W81 70015	High Speed Signal Processing Research	
CURRENT DENSITY	506 61 55	506 61 55	310 30 70	
High Density Circuit Technology	NASA End-to-End Data System (NEEDS) Phase 2	W81 70261	Mission Operations Technology	
506 54 60	506 61 56	W81 70262	310 40-45	
CV 990 AIRCRAFT	NASA End-to-End Data System (NEEDS) Data Base	W81 70263	Image Processing Technology	
Laser Heterodyne Spectrometer (LHS) Brassboard	Management/Archival Mass Memory		310 40-46	
147 40 01	506 61 59	W81 70263	Network Data Processing Development	
CYCLIC LOADS	Information Systems for Earth Observations for Space		310 40 72	
Life Prediction	540 01 13	W81 70277		
505 33 22	OSTA Data Systems Standards and Guidelines		DATA PROCESSING EQUIPMENT	
	656 13 10	W81 70390	Intelligent Systems Research	
CYTOLOGY	OSTA/ADS Data Systems Standards and Guidelines		506 54 83	
Blood Alterations (Influence of Space Flight on the	Program		University Research in Flight Testing Techniques	
Blood Forming Tissues)	656 13 10	W81 70391	505 36 24	
199 20 50	W81 70539	W81 70392	NASA Airborne Imaging Radar Facility	
		677 47 03	W81 70434	
D				
DAMAGE			DATA REDUCTION	
Life Prediction for Composite Materials			Space Calibration of Solar Cells	
505 33-23	506 61 31	542 03 20	Stratospheric Measurement Program Activities	
DATA ACQUISITION	NASA End-to-End Data System	146 60 01	Upper Atmosphere Research Satellites (UARS) Definition	
General Aviation Aircraft Aerodynamics and Flight	506-61 31	147 40 01	Study	
Dynamics	506-61 31	155 04-80	W81 70365	
505 41-18	506-61 31	Ground Based Optical Planetary Astronomy	W81 70478	
Airborne Experiment Platforms	506-61 31	196 41 80	Ground Based Radio and Radar Planetary Astronomy	W81 70529
530-02 18	506-61 31	196 41 85	196 41 85	W81 70532
Advanced Electronic Components	506-61 31	385 38 01	Solar Physics Data Analysis and Operations	W81 70559
506-54 63	506-61 31	385 38 01	Data Analysis Solar Physics	W81 70559
OEX (Orbiter Experiments) Project Support	506-61 31	389 41 01	Data Analysis Astronomy	W81 70560
506-63-31	506-61 31	389 41 01	High Energy Astrophysics Data Analysis	W81 70561
Shuttle Entry Air Data System (SEADS)	506-61 31	389-46 01	W81 70562	
506-63 32	506-61 31	389-46 03	Theoretical High Energy Astrophysics	W81 70563
Long Duration Exposure Facility	506-61 31	389 46-03	Navigation Technology Development	W81 70578
542 04 13	506-61 31	310 10 63	Telemetry Technology Development	W81 70586
Mars Data Analysis Program Geology	506-61 31	310 20 67	RFI Systems Technology	W81 70588
155 50 01	506-61 31	310 30 69	310 30 70	W81 70589
Medical Selection Criteria (Medical Evaluation and	506-61 31	310 40-45	Mission Operations Technology	W81 70592
Development of Standards for Space Crew Selection)	506-61 31	310 40-46	Image Processing Technology	W81 70592
199 10 20	506-61 31	310 40-46	Network Data Processing Development	W81 70593
Network Systems Technology Development	506-61 31	310 40 72	310 40 72	W81 70595
310-20 33	506-61 31			
DATA BASES			DATA RECORDING	
Applied Mathematics	506-61 31	506 54 83	University Research in Flight Testing Techniques	
505-31-83	506-61 31	677 47 03	505 36 24	
Aviation Safety Technology -Flight Safety	506-61 31		NASA Airborne Imaging Radar Facility	
505 44 23	506-61 31		W81 70434	
NASA End-to-End Data System	506-61 31			
506-61 55	506-61 31			
NASA End-to-End Data System (NEEDS) Data Base	506-61 31			
Management/Archival Mass Memory	506-61 31			
506 61 59	506-61 31			
Space System Studies - Information and Spacecraft	506-61 31			
Systems	506-61 31			
540 02 11	506-61 31			
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				
Advanced Electronic Components				
506-54 63				
OEX (Orbiter Experiments) Project Support				
506-63-31				
Shuttle Entry Air Data System (SEADS)				
506-63 32				
Long Duration Exposure Facility				
542 04 13				
Mars Data Analysis Program Geology				
155 50 01				
Medical Selection Criteria (Medical Evaluation and				
Development of Standards for Space Crew Selection)				
199 10 20				
Network Systems Technology Development				
310-20 33				
DATA BASES				
Applied Mathematics				
505-31-83				
Aviation Safety Technology -Flight Safety				
505 44 23				
NASA End-to-End Data System				
506-61 55				
NASA End-to-End Data System (NEEDS) Data Base				
Management/Archival Mass Memory				
506 61 59				
Space System Studies - Information and Spacecraft				
Systems				
540 02 11				
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				
Advanced Electronic Components				
506-54 63				
OEX (Orbiter Experiments) Project Support				
506-63-31				
Shuttle Entry Air Data System (SEADS)				
506-63 32				
Long Duration Exposure Facility				
542 04 13				
Mars Data Analysis Program Geology				
155 50 01				
Medical Selection Criteria (Medical Evaluation and				
Development of Standards for Space Crew Selection)				
199 10 20				
Network Systems Technology Development				
310-20 33				
DATA BASES				
Applied Mathematics				
505-31-83				
Aviation Safety Technology -Flight Safety				
505 44 23				
NASA End-to-End Data System				
506-61 55				
NASA End-to-End Data System (NEEDS) Data Base				
Management/Archival Mass Memory				
506 61 59				
Space System Studies - Information and Spacecraft				
Systems				
540 02 11				
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				
Advanced Electronic Components				
506-54 63				
OEX (Orbiter Experiments) Project Support				
506-63-31				
Shuttle Entry Air Data System (SEADS)				
506-63 32				
Long Duration Exposure Facility				
542 04 13				
Mars Data Analysis Program Geology				
155 50 01				
Medical Selection Criteria (Medical Evaluation and				
Development of Standards for Space Crew Selection)				
199 10 20				
Network Systems Technology Development				
310-20 33				
DATA BASES				
Applied Mathematics				
505-31-83				
Aviation Safety Technology -Flight Safety				
505 44 23				
NASA End-to-End Data System				
506-61 55				
NASA End-to-End Data System (NEEDS) Data Base				
Management/Archival Mass Memory				
506 61 59				
Space System Studies - Information and Spacecraft				
Systems				
540 02 11				
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				
Advanced Electronic Components				
506-54 63				
OEX (Orbiter Experiments) Project Support				
506-63-31				
Shuttle Entry Air Data System (SEADS)				
506-63 32				
Long Duration Exposure Facility				
542 04 13				
Mars Data Analysis Program Geology				
155 50 01				
Medical Selection Criteria (Medical Evaluation and				
Development of Standards for Space Crew Selection)				
199 10 20				
Network Systems Technology Development				
310-20 33				
DATA BASES				
Applied Mathematics				
505-31-83				
Aviation Safety Technology -Flight Safety				
505 44 23				
NASA End-to-End Data System				
506-61 55				
NASA End-to-End Data System (NEEDS) Data Base				
Management/Archival Mass Memory				
506 61 59				
Space System Studies - Information and Spacecraft				
Systems				
540 02 11				
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				
Advanced Electronic Components				
506-54 63				
OEX (Orbiter Experiments) Project Support				
506-63-31				
Shuttle Entry Air Data System (SEADS)				
506-63 32				
Long Duration Exposure Facility				
542 04 13				
Mars Data Analysis Program Geology				
155 50 01				
Medical Selection Criteria (Medical Evaluation and				
Development of Standards for Space Crew Selection)				
199 10 20				
Network Systems Technology Development				
310-20 33				
DATA BASES				
Applied Mathematics				
505-31-83				
Aviation Safety Technology -Flight Safety				
505 44 23				
NASA End-to-End Data System				
506-61 55				
NASA End-to-End Data System (NEEDS) Data Base				
Management/Archival Mass Memory				
506 61 59				
Space System Studies - Information and Spacecraft				
Systems				
540 02 11				
D				
DAMAGE				
Life Prediction for Composite Materials				
505 33-23				
DATA ACQUISITION				
General Aviation Aircraft Aerodynamics and Flight				
Dynamics				
505 41-18				
Airborne Experiment Platforms				
530-02 18				

SUBJECT INDEX

DUCTS

Oceanic Data Utilization System Study	W81-70395	RFI Systems Technology	W81-70588	Advanced Guidance and Control	Flight Systems
658 13-60		310-30 69		Experiments	
ADS Pilot Geosciences Information Network Development	W81-70396	High Speed Signal Processing Research	W81-70589	512 54 14	W81 70125
656 13-70		310 30 70		AFTI/F 16	
Applications Data Base Management System (ADBMS)	W81-70397	Network Data Processing Development	W81 70595	533 02 64	W81 70154
656-31-02		310-40 72		Systems for Underwater Survey and Exploration (SUSE)	
DATA SAMPLING		Network Productivity Research	W81 70596	637 01 02	W81-70381
Environmental Monitoring Research Satellite Mission Studies	W81-70349	310-40 73		DIGITAL TECHNIQUES	
146-60 02		Arrayed Network Technology	W81 70597	Aircraft Controls Reliability Enhancement	
DATA STORAGE		310-40 74		505-34-31	W81 70049
Space Vehicle Dynamics	W81 70206	Interagency and Industrial Assistance and Testing	W81 70097	Aircraft Controls Flight Systems Concepts	
506-53 69		505-43-33		505 34 34	W81-70052
NASA End-to-End Data System (NEEDS) Data Base Management/Archival Mass Memory	W81 70263	Interagency Assistance and Testing	W81 70098	DIODES	
506 61 59		505 43-34		Semiconductor Materials Growth in Low-g Environment	
Network Systems Technology Development	W81 70580	DEGRADATION		542-03-30	W81-70294
310-20-33		Effects of Space Environment on Composites	W81 70193	DIPLEXERS	
Technology for TDRSS User Spacecraft	W81-70582	506-53-25		X-Band Uplink Development	
310 20 46		DEMAGNETIZATION		310-20 64	W81 70583
Image Processing Technology	W81-70593	Experimental Magnetism	W81-70454	DIRECT POWER GENERATORS	
310-40-46		153-08 50		Ocean Thermal Energy Conversion Study and Assessment	
DATA SYSTEMS		DEMODULATORS		776-91 40	W81 70302
Advanced Electronic Components	W81-70216	Telemetry Technology Development	W81-70586	DIRECTIONAL ANTENNAS	
506 54-63		310-20 67		Technology for TDRSS User Spacecraft	
High Efficiency Technology for Microwave Amplifiers	W81 70250	DEPLOYMENT		310-20-46	W81-70582
506 61 22		Airborne Experiment Platforms	W81 70128	Antenna Systems Development	
NASA End-to-End Data System Information Adaptive System	W81 70260	530 02 18		310 20 65	W81 70584
506 61 53		DEPOSITION		DISASTERS	
NASA End-to-End Data System	W81 70261	Solid State Research Superconducting Circuitry	W81 70218	Phase B Studies - Landsat Solid State Sensor (LS3)	
506-61 55		506 54-69		677 29-09	W81-70417
NASA End-to-End Data System (NEEDS) Phase 2	W81 70262	DESIGN		DISPLAY DEVICES	
506 61-56		Space Vehicle Dynamics Methodology	W81 70204	Cockpit Avionics Generic	
Shuttle Entry Air Data System (SEADS)	W81 70272	506-53-65		505-34 23	W81-70048
506-63 32		Advanced Carbon-Carbon Stand Off Panel	W81 70197	Crew Interaction with Advanced Flight Systems	
Information Systems for Earth Observations for Space	W81 70277	506 53-37		505 35 23	W81 70057
540 01-13		Space Vehicle Dynamics Methodology	W81 70204	Human Factors Flight Research with High Performance Aircraft and RPVs	
OSTA Data Systems Standards and Guidelines	W81 70390	506 53 65		505-35 24	W81 70058
656-13 10		Payload Environments and Dynamics	W81 70205	Simulation Technology for Aeronautics	
OSTA/ADS Data Systems Standards and Guidelines Program	W81-70391	506-53 66		505 35 31	W81 70059
506 13 10		Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)	W81 70300	Application of Flight Simulation Technology	
Full Scale Applications Data Service (ADS) Planning Studies	W81-70392	776-91 19		505-35-33	W81 70060
Applications Data Service (ADS) Atmospheric Pilot System	W81 70393	Combustion Technology for Power Generation	W81-70304	General Aviation Avionics and Control Technology	
656-13-20		778 45 12		505 41 63	W81 70077
ADS Oceanic Pilot System Project	W81 70394	Phase B Studies Landsat Solid-State Sensor (LS3)	W81 70417	General Aviation Single Pilot IFR Systems	
Oceanic Data Utilization System Study	W81 70395	677 29 09		505-41-73	W81 70079
ADS Pilot Geosciences Information Network Development	W81 70396	Study of Large Deployable Antennas for Astronomy Applications	W81 70417	Integrated Avionic Control Systems for Rotorcraft	
656-13-70		358 78-60		505 42 31	W81 70085
Applications Data Base Management System (ADBMS)	W81 70397	Antenna Systems Development	W81 70553	Severe Storms and Local Weather Research	
656 31 02		310 20-65		146-50 02	W81 70344
Automated Mosaicking for Geocoded Data Bases	W81 70398	DETECTION		Magnetospheric Data Analysis	
656-33 01		Detection of Other Planetary Systems	W81 70524	385 36 01	W81-70555
Registration of Radar and Other Data	W81 70399	DETONATION		DIURNAL VARIATIONS	
656 45 02		Post Spill Liquid Hydrogen Behavior	W81 70014	Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere	
Data Analysis Astronomy	W81 70399	505 31-70		147 30 01	W81-70362
389 41-01		DIAGNOSIS		DOCUMENTATION	
Systems Management Technology	W81-70561	Photophysics and Laser Diagnostics	W81 70207	Solar Physics Data Analysis and Operations	
310 40 49		506-54 41		385 38-01	W81 70559
DATA TRANSMISSION		Ocular Screening System	W81-70321	High Energy Astrophysics Data Analysis	
Data Transmission and Processing Research	W81-70212	141-95 02		389 46 01	W81 70562
506-54 55		DIFFERENTIAL EQUATIONS		Theoretical High Energy Astrophysics	
Autonomous Process Control Technology for Earth Orbital Missions	W81-70251	Applied Mathematics	W81-70015	389 46-03	W81 70563
506 54-76		505-31 83		DOMESTIC SATELLITE COMMUNICATIONS SYSTEMS	
Ground Data Processing Technology Options Assessment for Missions of the 1985-1990 Time Frame	W81 70221	DIFFRACTION		Systems Coordination Support	
540 01 16		Quantum Electronics Sources	W81-70210	643-10-03	W81-70379
Network Systems Technology Development	W81 70279	506 54 45		DOPPLER RADAR	
310 20 33		DIFFUSE RADIATION		Aviation Operations Safety Technology Applied Laser Technology	
Satellite Communications Technology	W81 70580	Cosmic Background Explorer (COBE)	W81 70566	505-44 29	W81 70113
310 20 38		685 20 08		Severe Storms and Local Weather Research	
Telemetry Technology Development	W81 70581	DIFFUSION WELDING		146 50 02	W81-70345
310 20-67		SCR Materials and Structures	W81 70144	Gravity Field Survey Mission (GRAVSAT) Phase B Studies	
DECISION MAKING		533-01-13		677-29 04	W81-70415
Automated Decision Making and Problem Solving	W81 70219	DIGITAL COMPUTERS		DRAG REDUCTION	
506 54 73		Electronic Aircraft Engine Control	W81 70050	Turbulent Drag Reduction	
DECODING		505-34-32		505-31 23	W81 70004
High Speed Signal Processing Research	W81-70589	Seasat Digital SAR Processing (Renewable Resources)	W81 70436	General Aviation Aerodynamics and Handling Qualities Technology	
310-30 70		677 76-01		505 41 13	W81-70071
DEEP SPACE NETWORK		DIGITAL DATA		Laminar Flow Control	
NASA End to End Data System	W81-70261	Automated Mosaicking for Geocoded Data Bases	W81-70398	534-01-13	W81 70157
506 61 55		Integration of VIS IR NW Data	W81-70410	Aerodynamics of Ground Vehicles	
VLBI Development and Analysis	W81 70576	677 21 06		141 20 11	W81 70316
310 10 61		Alaska Wetlands Delineation Program	W81-70412	DRAINAGE	
Frequency and Timing Research	W81 70577	677 21 22		Remote Sensing of Subsurface Drain Malfunctions	
310 10 62		NASA Airborne Imaging Radar Facility	W81-70434	141 20-21	W81 70317
Navigation Technology Development	W81 70578	677 47 03		DROPS (LIQUIDS)	
310 10 63		Seasat Digital SAR Processing (Non Renewable Resources)	W81 70435	Development of a Shuttle Flight Experiment Drop Dynamics Module	
X-Band Uplink Development	W81 70583	677 48-01		542-03-01	W81 70289
310 20 64		DIGITAL SIMULATION		Electrostatic Control & Manipulation of Materials for Containerless Processing	
Antenna Systems Development	W81 70584	Simulation Technology for Aeronautics	W81 70059	179 20-56	W81-70368
310 20 65		505 35-31		DUCTED FAN ENGINES	
Telemetry Technology Development	W81 70584	Integration and Interfacing Technology	W81 70054	Heavy-Lift/Short Haul Hybrid Airship Technology	
310 20-67		505-34-43		505-42 51	W81-70086
DUCTS		General Aviation Avionics and Controls	W81 70078	DUCTS	
Oceanic Data Utilization System Study	W81-70586	505 41 68		Propulsion Noise Research	
658 13-60		Advanced Guidance and Control Systems Validation	W81 70124	505 32 02	W81 70017
ADS Pilot Geosciences Information Network Development	W81-70396	Technology	W81 70124	Propulsion Noise Research	
656 13-70		512-54-11		505 32-03	W81 70018

DUST		ADS Pilot Geosciences Information Network	ELECTRIC WIRE
Mars Data Analysis 155-04-80	WB1 70478	Development 656-13-70	Aircraft Fire Safety and Testing 505 44 27
DUST STORMS		Crustal Modeling Using Satellite Potential Field Data 677 45 01	WB1-70111
Planetary Aeolian Processes on Planets 151-01-60	WB1 70439	Seasat Digital SAR Processing (Non Renewable Resources) 677 48-01	Solar Rankine Cycle Applications Study 776 91 59
Dynamic Radiative Interaction 154 20 80	WB1 70461	WB1 70435	ELECTRICAL ENGINEERING
DYNAMIC CHARACTERISTICS		EARTH ROTATION Global Earth Dynamics and Structure 676 30-01	Aircraft Fire Safety and Testing 505 44 27
Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array 542 03-04	WB1 70290	WB1-70303	ELECTRICAL INSULATION
Stratospheric Research 147-30-02	WB1 70363	EARTH SURFACE Rock Type/Microwave Techniques (Imaging Radar Geology) 677-41 04	Aircraft Fire Safety and Testing 505 44 27
DYNAMIC CONTROL		Theoretical Studies of Radar Backscatter 677 41 11	ELECTRICAL PROPERTIES
Engine Dynamics and Controls Research 505-32-62	WB1 70026	Planetary Geology 151-01 70	Fire Resistant Materials 505 33-31
DYNAMIC RESPONSE		WB1 70440	ELECTRO-OPTICAL EFFECT
General Aviation Crash Dynamics 505 41 33	WB1-70074	EARTH TIDES Global Earth Dynamics and Structure 676 30 01	Quantum Electronics Devices and Sensors 506-54-43
Aviation Safety Technology Applied Fluid Mechanics 505 44 25	WB1 70110	WB1-70036	ELECTRO-OPTICS
Space Shuttle Aerodynamic Experiments 506-51 34	WB1-70179	EARTHQUAKES Regional Crustal Deformation Modeling 676-10 10	Aviation Operations Safety Technology 505-44 29
Loads Dynamics and Aeroelasticity 506-53 64	WB1 70203	Advanced Geodynamics Studies 676 59-30	Applied Laser Technology 506-54-43
DYNAMIC STABILITY		WB1 70405	Quantum Electronics Devices and Sensors 506-54-43
Tilt Rotor Research Aircraft Flight Investigations 532-04-11	WB1 70137	ECOLOGY Global Terrestrial Ecology 199 70 31	Sensor Systems Technology 506-61-33
DYNAMIC STRUCTURAL ANALYSIS		WB1 70546	ELECTROCHEMISTRY
Loads Aeroelasticity and Structural Dynamics 505-33-53	WB1 70040	ECONOMIC ANALYSIS General Aviation System Technology Studies 530-01 13	Electrochemical Energy Conversion and Storage 506-55 52
Rotocraft Aeroelasticity and Structural Dynamics 505-42-11	WB1-70081	WB1 70126	Ozone Data Reduction and Analysis and Solar UV Variability 146-60 01
Loads Dynamics and Aeroelasticity 506 53-63	WB1 70202	ECONOMIC FACTORS	ELECTROHYDRODYNAMICS
Space Vehicle Dynamics Methodology 506-53-65	WB1-70204	Shuttle Derived Vehicle Technology Requirements 540-03-19	Electrostatic Control & Manipulation of Materials for Containerless Processing 179 20 56
Payload Environments and Dynamics 506 53 66	WB1 70205	WB1 70285	WB1 70236
Space Vehicle Dynamics 506-53-69	WB1 70206	ECONOMICS	Orbital Energy Storage and Power Systems (H2/O2) 506 55 57
Radiative Transfer in Cloudy Atmosphere 154 40 80	WB1 70464	Long Haul Transport Aircraft Systems Studies 530-04-13	Regenerative Fuel Cell/Electrolysis Cell Hydrogen/Halogen 776-91 17
E		EDUCATION	WB1 70299
EARTH (PLANET)		CFD Training Program 505-36-20	ELECTROLYSIS
Planetary Dynamics 153-05 70	WB1 70450	WB1 70065	Electrochemical Energy Conversion and Storage 506-55 52
EARTH ATMOSPHERE		EJECTORS V/STOL Propulsion System Technology 532-05 12	Orbital Energy Storage and Power Systems (H2/O2) 506 55 57
Planetary Aeronomy Theory and Analysis 154-60-80	WB1-70467	WB1 70140	Regenerative Fuel Cell/Electrolysis Cell Hydrogen/Halogen 776 91 17
Extended Atmospheres 154 80-80	WB1 70474	ELASTIC SCATTERING	Fluid and Electrolyte Change 199-20 60
EARTH CRUST		Aeronomy Energy Deposition 154 70 80	WB1 70540
Regional Crustal Deformation Modeling 676-10 10	WB1 70402	WB1-70470	ELECTROMAGNETIC FIELDS
Advanced Geodynamics Studies 676 59 30	WB1-70405	EARTHLERS Aircraft Systems Operational Safety and Efficiency Improvement 505 44 31	Data Analysis - Space Plasma Physics 385 36-02
Integrated Study of Continental Rift Systems 677 43 05	WB1 70427	Fuel Tank Sealants 533 01 11	WB1 70557
Crustal Modeling Using Satellite Potential Field Data 677 45 01	WB1-70429	Fundamentals of Mechanical Behavior of Composites Matrices 506-53 15	Remotely Sensed Electromagnetic Characteristics of Snow and Soil Moisture 677 22-12
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies 677 45-03	WB1-70430	WB1 70190	ELECTROMAGNETIC PROPULSION
Magmat Correlative Studies 677-45 04	WB1 70431	ELECTRIC BATTERIES	Ion Thruster Research and Ion Beam Applications 506-55 32
EARTH MANTLE		Electrochemical Energy Conversion and Storage 506 55-52	WB1 70231
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies 677 45-03	WB1 70430	ELECTRIC CONTROL	ELECTROMAGNETIC RADIATION
Information Systems for Earth Observations for Space 540-01 13	WB1 70277	Advanced Guidance and Control Experiments 512 54-14	Quantum Electronics Sources 506-54 45
Great Lakes Water Quality Research 146 40 18	WB1-70343	Multi KW Low Cost Earth Orbital Systems 506 55 79	Atmosphere Ionosphere Magnetosphere Interactions 385 36 01
Integration of VIS IR NW Data 677 21 06	WB1 70410	WB1 70243	WB1-70210
Surface Mine Rehabilitation Inventory and Monitoring 677 21 20	WB1-70411	ELECTRIC CURRENT	Atmosphere Ionosphere Magnetosphere Interactions 385 36 01
Demonstration Flight System and Operational Land Observing System (OLOS) 677 29-06	WB1-70416	Data Analysis Solar Physics 385-38 01	WB1-70554
Phase B Studies Landsat Solid State Sensor (LS3) 677-29 09	WB1 70417	WB1 70560	ELECTROMECANICAL DEVICES
Seasat Digital SAR Processing (Renewable Resources) 677 76 01	WB1-70436	ELECTRIC FIELDS	Aircraft Controls Electromechanical Actuator Technology 505 34-37
EARTH PLANETARY STRUCTURE		Electrostatic Control & Manipulation of Materials for Containerless Processing 179 20 56	WB1 70053
Global Earth Dynamics and Structure 676 30 01	WB1-70403	WB1-70368	ELECTRON BEAMS
Geopotential Field Models 676-40-01	WB1 70404	Atmosphere Ionosphere Magnetosphere Interactions 385 36 01	Electrophysics 506-54 42
EARTH RADIATION BUDGET EXPERIMENT		Sounding Rockets Magnetospheric Physics Experiments 828-11 36	Satellite Communications Technology 541 02-12
Climate Research 146 10 03	WB1 70324	WB1 70554	ELECTRON IMPACT
Radiation Budget and Aerosol Studies 146 10 06	WB1 70326	WB1 70306	Aeronomy Energy Deposition 154 70-80
EARTH RESOURCES		Utility Power Supply and Load Management 778 50-15	WB1 70470
Coastal and Estuarine Dynamic Processes Research 146-40 15	WB1 70341	WB1-70314	ELECTRON MICROSCOPES
		ELECTRIC GENERATORS	Instrument Definition 157 03 01
		Space Propulsion and Power System Studies 540 02-12	WB1 70487
		Power Generation Concepts and Applications 778-46 12	ELECTRON MOBILITY
		WB1 70306	High Density Circuit Technology 506 54 60
		WB1 70314	WB1 70215
		ELECTRIC POWER PLANTS	ELECTRONIC COUNTERMEASURES
		Combustion Technology for Power Generation 778 45-12	High Efficiency Technology for Microwave Amplifiers 506-61 22
		WB1 70304	WB1-70250
		ELECTRIC POWER SUPPLIES	ELECTRONIC EQUIPMENT
		Multi KW Low Cost Earth Orbital Systems 506-55 79	High Density Circuit Technology 506 54 60
		WB1 70243	WB1 70215
		ELECTRIC PROPELLION	ELECTRONIC PACKAGING
		Ion Thruster Research and Ion Beam Applications 506 55 32	Spacelab 2 Superfluid Helium Experiment 542-03-13
		WB1 70231	WB1 70291
		MPD Thruster System Technology 506-55-35	ELECTROPHORESIS
		WB1 70232	Bioseparation 179 80-80
		Earth Orbital Platform Systems - Auxiliary Electric Propulsion for Spacecraft Systems 506-62 62	WB1 70374
		WB1 70266	ELECTROPHYSICS
		Space Propulsion and Power System Studies 540-02-12	Electrophysics 506-54-42
		WB1-70281	Quantum Electronics Sources 506-54 45
		Flight Test of an Ion Auxiliary Propulsion System (IAPS) 542-05-12	WB1 70208
		WB1 70297	WB1 70210

SUBJECT INDEX

ELECTROSTATICS

Electrostatic Control & Manipulation of Materials for Containerless Processing
179-20 56 W81 70368

ENCAPSULATED MICROCIRCUITS

Solar Cell Technology
506 55 42 W81 70233

ENERGETIC PARTICLES

Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn
385 36-04 W81 70558

Sounding Rockets Magnetospheric Physics Experiments
828 11 36 W81 70568

ENERGY CONSERVATION

Commercial Aircraft Fuel Savings
505 44-32 W81 70115

Laminar Flow Control
534 01 13 W81 70157

Energy Efficient Transport Wind Tunnel Testing
534-02-11 W81 70159

Energy Efficient Transport
534 02 13 W81 70160

Energy Efficient Engine Project
535 01 12 W81 70167

Waste Heat Automotive Air Conditioner
778-48 17 W81 70312

Industrial Conservation Cogeneration and Utilization of Alternative Fuels
778 49 15 W81-70313

Utility Power Supply and Load Management
778 50 15 W81 70314

Aerodynamics of Ground Vehicles
141-20 11 W81 70316

ENERGY CONVERSION

Advanced Energetics
506 55 12 W81 70226

Advanced Energy Technology
506 55 15 W81 70228

Solar Cell Technology
506-55-42 W81 70233

Solar Cell Research
506 55 43 W81 70234

Electrochemical Energy Conversion and Storage
506 55 52 W81 70236

Orbital Energy Storage and Power Systems (H2/O2)
506-55-57 W81 70238

Thermal Electric and Thermionic Energy Conversion Technology
506 55-65 W81 70239

Advanced Power System Technology
506 55 76 W81 70242

Multi-KW Low Cost Earth Orbital Systems
506-55-79 W81 70243

Fund for Independent Research (Space)
506-56-12 W81 70245

Studies in Bioenergy
776 91 35 W81 70301

Energy Planning Support at JPL
778-45-35 W81 70305

Advanced Coal Processing Concepts
778-47-15 W81 70309

Coal Conversion Processes and Systems
778 47 29 W81 70310

Advanced Energy Technology for Utilities
778-50 29 W81-70315

Experiment Development - Laboratory and Theoretical
Solar Physics
170-38-53 W81 70499

ENERGY CONVERSION EFFICIENCY

Solar Cell Technology
506-55 42 W81-70233

Solar Cell Research
506-55 43 W81 70234

Planetary Solar Array Research and Technology
506-55-45 W81 70235

Electrochemical Energy Conversion and Storage
506-55-52 W81 70236

ENERGY DISSIPATION

Upper Atmosphere Research Satellites (UARS) Definition
Study
147-40 01 W81 70365

Origins of Plasma in the Earth's Neighborhood (OPEN)
171 03-00 W81 70500

ENERGY SOURCES

Studies in Bioenergy
776 91-35 W81 70301

Power Generation Concepts and Applications
778-48 12 W81 70306

UV and Optical Astronomy
188 41 51 W81 70501

ENERGY SPECTRA

Particle Astrophysics and Shuttle Experiment Definition
188 46-56 W81 70509

Gamma Ray Astronomy
188 46-57 W81-70510

ENERGY STORAGE

Advanced Energetics
506 55-12 W81 70226

Advanced Energy Technology
506 55-15 W81 70228

MPD Thruster System Technology
506 55-35 W81-70232

Electrochemical Energy Conversion and Storage
506-55 52 W81-70236

Orbital Energy Storage and Power Systems (H2/O2)
506 55-57 W81 70238

Power Systems Management and Distribution
506-55 72 W81-70240

Advanced Power System Technology
506-55-76 W81-70242

Space Propulsion and Power System Studies
540-02 12 W81 70281

Regenerative Fuel Cell/Electrolysis
Cell-Hydrogen/Halogen
776-91 17 W81-70299

Utility Power Supply and Load Management
778-50 15 W81-70314

Origins of Plasma in the Earth's Neighborhood (OPEN)
171-03 00 W81-70500

ENERGY TECHNOLOGY

Advanced Energetics
506-55 12 W81-70226

Advanced Energy Technology
506-55-15 W81-70228

Integrated Modular Solar Energy Systems (Small
Dispersed Solar Energy Systems Applications)
776 91 19 W81 70300

Ocean Thermal Energy Conversion Study and
Assessment
776 91 40 W81 70302

Power Generation Concepts and Applications
778 46 12 W81 70306

Coal Conversion Processes and Systems
778 47 29 W81 70310

ENERGY TRANSFER

MPD Thruster System Technology
506 55-35 W81 70232

Upper Atmosphere Research Satellites (UARS) Definition
Study
147 40-01 W81 70365

Planetary Atmospheric Dynamics
154 20 80 W81 70459

Planetary Aeronomy Theory and Analysis
154-60-80 W81 70467

ENGINE CONTROL

Electronic Aircraft Engine Control
505 34-32 W81-70050

V/STOL Propulsion System Technology
532-05-12 W81 70140

ENGINE DESIGN

Combustion and Emissions Reduction Research
505-32 32 W81 70023

Advanced Engine System Concepts
505-32 92 W81-70029

Integrated Analysis and Synthesis
505-33 62 W81 70043

High Temperature Structures
505 33 72 W81-70045

Advanced General Aviation Propulsion Research
505 41 22 W81-70073

Aeroelasticity of Turbine Engines
510-55 12 W81 70119

Advanced Low Emission Combustor (ALEC)
511 55 12 W81 70121

Broad Property Fuels Technology
511 59 12 W81-70123

Propulsion Systems for Small Transports
530 04 12 W81 70129

Advanced Propulsion System Concepts
530 05 12 W81 70131

QPLT Systems Technology
532 02-12 W81 70135

Advanced Rotorcraft Propulsion Technology
532 06 12 W81 70141

SCR Propulsion Technology
533 01 32 W81 70146

Propulsion System/Airframe Integration Technology
533 01-62 W81 70148

SCR - Airframe/Propulsion System Interactions
533 01-63 W81 70149

Energy Efficient Engine Project
535 01 12 W81 70167

Variable Cycle Engine Technology
535 02-12 W81 70168

Advanced Turboprop Program
535-03-12 W81 70169

Stirling Engine Components and System Concepts
778-46-22 W81 70307

Validation of Stirling Lab Engine
778 46-35 W81-70308

ENGINE INLETS

Graduate Research Program in Aeronautics
505-36-22 W81-70067

Energy Efficient Engine Project
535-01 12 W81 70167

Variable Cycle Engine Technology
535-02 12 W81-70168

Stirling Engine Components and System Concepts
778-46-22 W81 70307

ENGINE MONITORING INSTRUMENTS

Propulsion Instrumentation Research
505 32 82 W81-70028

ENGINE NOISE

Noise Reduction Technology for Short Haul Aircraft
505-32 01 W81-70016

Propulsion Noise Research
505 32 02 W81 70017

Propulsion Noise Research
505 32-03 W81-70018

Basic Noise Research
505 32 05 W81 70019

EXHAUST NOZZLES

Graduate Research Program in Aeronautics
505-36-22 W81 70067

Energy Efficient Engine Project
535-01 12 W81 70167

Variable Cycle Engine Technology
535-02 12 W81-70168

Stirling Engine Components and System Concepts
778-46-22 W81-70307

ENGINE PARTS

Propulsion Instrumentation Research
505-32 82 W81 70028

Integrated Analysis and Synthesis
505-33-62 W81-70043

Advanced Rotorcraft Propulsion Technology
532 06 12 W81-70141

ENGINE TESTS

Propulsion Noise Research
505 32 02 W81 70017

Advanced General Aviation Propulsion Research
505 41 22 W81-70073

Turbine Engine Hot Section Technology (HOST)
510 57 12 W81-70120

Energy Efficient Engine Project
535-01 12 W81 70167

Stirling Engine Components and System Concepts
778-46-22 W81-70307

Validation of Stirling Lab Engine
778 46-35 W81 70308

ENVIRONMENT EFFECTS

Aviation Meteorology Research Basic Atmospheric
Processes
505-44-19 W81-70106

Effects of Space Environment on Composites
506-53-25 W81 70193

Long Term Space Environmental Effects on Materials
506-53-29 W81 70194

Aerosol Climatic Effects Special Study
146-10-04 W81-70325

ENVIRONMENT SIMULATION

Experimental Studies
153-02 40 W81 70447

Interior Models
153-03 42 W81-70449

ENVIRONMENTAL CONTROL

Thermal Control System Technology
506 53 39 W81 70198

Curation of Extraterrestrial Samples
152 04 40 W81 70444

Systems Habitability Verification
199-10 41 W81-70537

ENVIRONMENTAL ENGINEERING

Pipeline/Nuclear Plant Engineering Geology
677 44 01 W81 70428

ENVIRONMENTAL MONITORING

Stratospheric Measurement Program Activities
146-60 01 W81 70347

ENVIRONMENTAL QUALITY

Ozone Data Reduction and Analysis and Solar UV
Variability
146 60 01 W81 70346

EPIDEMIOLOGY

Medical Selection Criteria (Medical Evaluation and
Development of Standards for Space Crew Selection)
199 10-20 W81 70353

EPITAXY

Fundamental Electronics
506 54 65 W81 70217

Planetary Solar Array Research and Technology
506 55 45 W81-70235

EQUATIONS OF MOTION

CFD Training Program
505-36-20 W81 70065

ERYTHROCYTES

Blood Alterations (Influence of Space Flight on the
Blood Forming Tissues)
199 20 50 W81 70539

ESTUARIES

Coastal and Estuarine Dynamic Processes Research
146-40 15 W81 70341

EUROPA

Extended Atmospheres
154 80 80 W81 70475

EVALUATION

Seasat Data Utilization Project
146-01 00 W81 70322

EXCITATION

Effects of Space Environment on Composites
506 53 25 W81 70193

EXHAUST EMISSION

Advanced General Aviation Propulsion Research
505 41 22 W81 70073

EXHAUST GASES

Combustion and Emissions Reduction Research
505-32 32 W81 70023

Advanced Low Emission Combustor (ALEC)
511-55 12 W81 70121

Long Haul Transport Aircraft Systems Studies
530 04 13 W81 70130

Plume Characterization
506-52-39 W81 70186

Stirling Engine Components and System Concepts
778-46-22 W81-70307

EXHAUST NOZZLES

Combat Veh & Missile Aerodyn & Flight Dyn R & T
505 43-22 W81-70094

EXPERIMENTAL DESIGN

SUBJECT INDEX

SCR - Airframe/Propulsion System Interactions			
533 01-63	W81 70149		
EXPERIMENTAL DESIGN			
Utilization of Space for Science Experiments			
506-56-29	W81 70249		
Development of a Shuttle Flight Experiment Drop Dynamics Module			
542 03 01	W81 70289		
Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array			
542 03-04	W81 70290		
Spacelab 2 Superfluid Helium Experiment			
542 03 13	W81 70291		
Cryogenic Fluid Management			
542-03-52	W81 70295		
Long Duration Exposure Facility			
542 04 13	W81 70296		
Shuttle Time and Frequency Transfer Experiment (STIFT)			
676-59 41	W81 70409		
Experimental Studies			
153-02 40	W81 70447		
Instrument Development for Spaceflight Experiments			
157 03 40	W81 70488		
Development of Experiments and Hardware for Solar Physics Research			
170 38-51	W81 70495		
Development of Solar Spacelab Experiment and Hardware			
170 38-51	W81 70496		
Experiment Development - Laboratory and Theoretical Solar Physics			
170 38 53	W81 70499		
EXPERIMENTATION			
Airborne Experiment Platforms			
530 02-18	W81 70128		
EXPLORER SATELLITES			
Extreme Ultraviolet Explorer			
685 20 06	W81 70565		
EXTERNAL STORES			
Flight Loads and Aeroelasticity			
505 33-54	W81 70041		
Decoupler Pylon Flight Demonstration			
533-02-73	W81 70155		
EXTRAGALACTIC RADIO SOURCES			
Mars Data Analysis Astronomy			
156-41 80	W81 70482		
Earth Based Solar System Observations			
198-41 78	W81 70528		
Radio Metric Analysis Demonstration and Instrumentation Development			
310-10 60	W81 70575		
EXTRATERRESTRIAL MATTER			
Experimental Magnetism			
153-08-50	W81 70454		
EXTRATERRESTRIAL RADIATION			
Radiation Effects and Protection RTOP			
199 20 70	W81 70541		
EXTREMELY HIGH FREQUENCIES			
30/20 GHz Wideband System Definition			
650 20-16	W81 70384		
GHz Wideband Communications Satellite Project Definition			
650 60 18	W81 70385		
Satellite Switching and Processing Systems			
650-60-21	W81-70387		
Antenna Systems Development			
310 20-65	W81 70584		
Radio Systems Development			
310 20 66	W81 70585		
EYE (ANATOMY)			
Ocular Screening System			
141 95-02	W81-70321		
F			
F-104 AIRCRAFT			
Aircraft Operational Support			
505 43-54	W81-70100		
F-111 AIRCRAFT			
Interagency Assistance and Testing			
505-43-34	W81 70098		
Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F-111)			
533-02 14	W81 70150		
F-14 AIRCRAFT			
Advanced Flight Experiments	F-14	High	
Angle-of-Attack			
533 02 34	W81-70152		
F-16 AIRCRAFT			
Advanced Flight Experiments	F-14	High	
Angle-of-Attack			
533 02 34	W81 70098		
AFTI/F-16			
533 02-64	W81-70154		
F-18 AIRCRAFT			
Interagency Assistance and Testing			
505-43 34	W81-70098		
FABRICATION			
Interdisciplinary Research in Composite Structures			
505 33-60	W81-70042		
High Temperature Aeronautical Structures			
505-33-73	W81-70046		
FABRY-PEROT INTERFEROMETERS			
Signal Detection and Processing			
506 54 56	W81 70213		
FACE CENTERED CUBIC LATTICES			
Experimental Magnetism			
153 08 50	W81 70454		
FAIL SAFE SYSTEMS			
Aircraft Controls Reliability Enhancement			
505-34 31	W81 70049		
FAILURE MODES			
Fatigue Damage and Environmental Effects in Metals and Composites			
505 33 21	W81 70033		
Aircraft Systems Operational Safety and Efficiency Improvement			
505-44 31	W81 70114		
Failure and Thermal Analysis			
506 53 53	W81 70200		
FANS			
Aeroelasticity of Turbine Engines			
510 55 12	W81 70119		
FAR FIELDS			
Advanced Turboprop Interior Noise			
535-03 13	W81 70170		
FAR INFRARED RADIATION			
Infrared Detectors Far IR Sensors			
506 61-31	W81 70253		
Atomic and Molecular Properties			
154-50 80	W81 70466		
FAST FOURIER TRANSFORMATIONS			
High Speed Signal Processing Research			
310 30-70	W81 70589		
FATIGUE (MATERIALS)			
Advanced Aluminum Alloys			
505-33 13	W81 70032		
Composites for Advanced Space Systems			
506 53 23	W81 70192		
FATIGUE LIFE			
Life Prediction			
505 33 22	W81 70034		
Life Prediction for Composite Materials			
505 33 23	W81 70035		
SCR Materials and Structures			
533 01 13	W81 70144		
FEASIBILITY ANALYSIS			
Airborne Experiment Platforms			
530 02 18	W81 70128		
Applications Data Base Management System (ADBMS)			
656 31 02	W81 70397		
Demonstration Flight System and Operational Land Observing System (OLOS)			
677 29 06	W81-70416		
Spacelab Science Payload Definitions	ATD	General	
358 78-01	W81 70552		
FEEDBACK CONTROL			
Autonomous Process Control Technology for Earth Orbital Missions			
506 54 76	W81 70221		
FERROFLUIDS			
Tribological Experiments in Zero Gravity			
542 03-27	W81 70293		
FIBER OPTICS			
Integration and Interfacing Technology			
505-34 43	W81 70054		
Quantum Electronics Devices and Sensors			
506-54-43	W81 70209		
Data Transmission and Processing Research			
506 54-55	W81 70212		
Precision Pointing and Control Technology (PPACT) Development			
506-54 95	W81 70225		
Glass Research			
179-80 30	W81 70373		
Frequency and Timing Research			
310 10-62	W81 70577		
Network Systems Technology Development			
310-20 33	W81-70580		
FIGHTER AIRCRAFT			
High Performance Aircraft Airframe Propulsion Integration			
505 43 21	W81 70093		
Combat Veh & Missile Aerodyn & Flight Dyn R & T			
505-43-22	W81 70094		
Combat Vehicle and Missile Aerodynamics and Flight Dynamics			
505-43 23	W81 70095		
Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F-111)			
533-02-14	W81-70150		
Advanced Flight Experiments F 14 High Angle of Attack			
533 02 34	W81 70152		
AFTI/F 16			
533 02 64	W81 70154		
Highly Maneuvering Aircraft Technology			
533 03-13	W81-70156		
FILE MAINTENANCE (COMPUTERS)			
Software Engineering Technology			
310 10 23	W81 70572		
FILTRATION			
Analysis of Multifrequency/Multipolarization SAR			
Imagery			
677-41-12	W81-70423		
FINANCIAL MANAGEMENT			
Funds for Independent Research (Space)			
506 56-11	W81-70244		
Fund for Independent Research (Space)			
506 56 12	W81 70245		
Fund for Independent Research (Space)			
506 56 13	W81-70246		
JSC General Operations Geophysics and Geochemistry			
153 10 40	W81 70456		
Data Reproduction in Support of the Mars Data Analysis Program			
155 50 01	W81-70484		
FINITE DIFFERENCE THEORY			
Computational Fluid Mechanics for Turbomachinery			
505 32 52	W81 70025		
Dynamics of Planetary Atmospheres			
154 20 80	W81 70460		
FINITE ELEMENT METHOD			
Computational Fluid Mechanics for Turbomachinery			
505-32 52	W81-70025		
FIRE CONTROL			
AFTI/F 16			
533 02 64	W81-70154		
FIRE DAMAGE			
Fire Systems Full Scale Test			
534-05 17	W81 70166		
FIRE EXTINGUISHERS			
Aviation Safety Technology - Operational Problems and Fireworthiness			
505 44 21	W81 70107		
FIRE PREVENTION			
Aviation Safety Technology Operational Problems and Fireworthiness			
505 44 21	W81 70107		
FISHERIES			
Commercial Fisheries Ocean Forecast Demonstration			
663-90-03	W81 70401		
FISSION			
Development of a Shuttle Flight Experiment Drop Dynamics Module			
542 03 01	W81 70289		
FLAME RETARDANTS			
Aircraft Fire Safety and Testing			
505-44 27	W81 70111		
Fire Systems Full Scale Test			
534 05 17	W81 70166		
FLAMMABILITY			
Aviation Safety Technology Operational Problems and Fireworthiness			
505-44 21	W81 70107		
FLARED BODIES			
Commercialization an Orbital Tube Flaring System			
141 95 01	W81 70319		
FLIGHT ALTITUDE			
Microwave Technology Development for Atmospheric Turbulence Studies			
505-44 15	W81-70104		
FLIGHT CHARACTERISTICS			
General Aviation Aircraft Aerodynamics and Flight Dynamics			
505-41 18	W81 70072		
Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research			
505 42 71	W81 70088		
AV-8A V/STOL Flight Experiments			
505-42 74	W81 70089		
Flight Dynamics and Handling Qualities			
505-43 14	W81 70092		
Quiet Propulsive-Lift Technology Experiments Aircraft Performance and Operating Systems Research			
532 02 11	W81 70134		
QPLT Systems Technology			
532 02 12	W81 70135		
Tilt Rotor Research Aircraft Flight Investigations			
532 04 11	W81-70137		
Flight Test of the Tilt Rotor Research Aircraft			
532 04 14	W81 70138		
V/STOL Systems Technology			
532 05 11	W81 70139		
Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F 111)			
533 02 14	W81 70150		
Advanced Flight Experiments F-14 High Angle of Attack			
533 02 34	W81 70152		
AFTI/F 16			
533 02 64	W81 70154		
Highly Maneuvering Aircraft Technology			
533 03-13	W81-70156		
FLIGHT CONTROL			
Aircraft Controls Reliability Enhancement			
505 34 31	W81-70049		
Aircraft Controls Electromechanical Actuator Technology			
505 34 37	W81 70053		
General Aviation Avionics and Controls			
505-41 68	W81 70078		
General Aviation Single Pilot IFR Systems			
505-41 73	W81 70079		

SUBJECT INDEX

Aerial Applications Aerodynamics and Systems Interaction	W81-70080
505-41 83 Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research	W81-70088
505 42 71 Integrated Research Aircraft Control Technology	W81 70153
533-02 44 AFTI/F 16	W81 70154
533 02-64 Space Shuttle Aerodynamic Experiments	W81 70179
506-51 34	W81 70179
FLIGHT CREWS	
Flight Management Systems	W81 70056
505-35-21	W81 70056
FLIGHT HAZARDS	
Aviation Meteorology Research	W81 70101
505-44-12 Aviation Meteorology Research - Severe Storms	W81 70102
505 44-13 Knowledge of High Altitude Atmospheric Processes	W81 70103
505-44-14 Microwave Technology Development for Atmospheric Turbulence Studies	W81 70104
505-44-15	W81 70104
FLIGHT INSTRUMENTS	
University Research in Flight Testing Techniques	W81-70069
505-36-24 Space Shuttle Aerodynamic Experiments	W81-70069
506-51 34 Fund for Independent Research	W81-70179
506 56-19	W81-70248
FLIGHT MECHANICS	
Aeronautics Graduate Research Program - FY 1981	W81-70066
505-36 21 Planetary Probe Aerothermodynamic Technology	W81-70175
506-51 21 Space Shuttle Development Support	W81-70269
506-63-13 ACIP - (Aerodynamic Coefficient Identification Package)	W81-70270
506-63 27 OEX (Orbiter Experiments) Project Support	W81-70271
506-63 31 Shuttle Entry Air Data System (SEADS)	W81-70272
506-63 32 Shuttle Upper Atmospheric Mass Spectrometer (SUMS)	W81-70276
506-63 37	W81-70276
FLIGHT PATHS	
Navigation and Guidance Short Range Operations	W81 70047
505-34 11	W81 70047
FLIGHT PLANS	
Commercial Aircraft Fuel Savings	W81 70115
505-44 32	W81 70115
FLIGHT SAFETY	
Aviation Meteorology Research	W81 70101
505-44 12 Aviation Meteorology Research Severe Storms	W81 70102
505 44 13	W81 70102
FLIGHT SIMULATION	
Application of Flight Simulation Technology	W81 70060
505-35 33 Aviation Safety Technology Operational Problems and Fireworthiness	W81 70107
505 44 21 Environmental Monitoring Research Satellite Mission Studies	W81 70107
146-60 02	W81 70349
FLIGHT SIMULATORS	
Simulation Technology for Aeronautics	W81 70059
505 35-31 Interagency and Industrial Assistance and Testing	W81-70096
505 43-31 Interagency and Industrial Assistance and Testing	W81-70097
505 43-33	W81-70097
FLIGHT TEST INSTRUMENTS	
High Performance Aircraft Flight Test Support	W81-70151
533 02-24	W81-70151
FLIGHT TESTS	
Flight Research Instrumentation Development	W81-70012
505 31-54 University Research in Flight Testing Techniques	W81-70089
505 36-24 General Aviation Aerodynamic Performance Technology	W81-70070
505 41-11 General Aviation Aerodynamics and Handling Qualities Technology	W81-70070
505 41-13 AV 8A V/STOL Flight Experiments	W81-70071
505 42-74 Flight Dynamics	W81-70089
505 43-13 Flight Dynamics and Handling Qualities	W81 70091
505 43-14 Remotely Piloted Research Aircraft Technology	W81 70092
505 43 44 Microwave Technology Development for Atmospheric Turbulence Studies	W81 70104
505 44 15 Advanced Guidance and Control Flight Systems Experiments	W81 70125
512 54 14 Tilt Rotor Research Aircraft Flight Investigations	W81 70137

FREQUENCY ASSIGNMENT

Flight Test of the Tilt Rotor Research Aircraft	W81-70138
532 04 14 SCR Materials and Structures Flight Research	W81-70145
533 01 14 Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F 111)	W81 70150
533 02 14 High Performance Aircraft Flight Test Support	W81-70151
533 02-24 Advanced Flight Experiments F-14 High Angle-of Attack	W81-70152
533 02-34 Decoupler Pylon Flight Demonstration	W81-70155
533 02-73 Laminar Flow Control (Leading Edge Glove) - Flight Research	W81-70158
534-01-14 Energy Efficient Transport Flight Research	W81-70161
534-02-14 Advanced Turboprop- Interior Noise	W81-70170
535-03-13 Advanced Turboprop Flight Research	W81-70171
535-03 14 Fund for Independent Research	W81-70248
506-56 19 Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array	W81 70290
542-03 04 Flight Test of an Ion Auxiliary Propulsion System (IAPS)	W81-70297
542-05 12	W81-70297
FLIGHT TRAINING	
Flight Management Systems	W81-70056
505-35 21	W81-70056
FLOW	
Concepts for Improved Ground Transportation Systems	W81-70311
778-48 15	W81-70311
FLOW CHARACTERISTICS	
Fan Compressor and Turbine Research	W81-70022
505-32 22 Computational Fluid Mechanics for Turbomachinery	W81-70025
505-32 52	W81-70025
FLOW DISTRIBUTION	
Turbulence and Modeling	W81 70003
505 31 21 Propulsion Noise Research	W81-70018
505 32 03 Computational and Experimental Aerothermodynamics	W81 70173
506 51 11 Space Vehicle Aerothermodynamics and Configuration Technology	W81 70174
506 51 13 OEX Flight Data Analysis	W81 70175
506 51-21 Plume Characterization	W81 70177
506 52-39 Shuttle Entry Air Data System (SEADS)	W81 70272
506 63-32	W81 70272
FLOW EQUATIONS	
Numerical Aerodynamic Simulator (NAS Project)	W81 70172
536-01-11	W81 70172
FLOW MEASUREMENT	
Noise Reduction Technology for Short-Haul Aircraft	W81-70016
505 32-01 Computational and Experimental Aerothermodynamics	W81-70173
506-51-11	W81-70173
FLOW VELOCITY	
Sounding Rockets Experiment	W81-70569
828-11-38	W81-70569
FLOW VISUALIZATION	
Basic Noise Research	W81-70019
505-32 05 Aerodynamics of Ground Vehicles	W81-70316
141-20 11	W81-70316
FLOWMETERS	
Flight Research Instrumentation Development	W81-70012
505-31 54	W81-70012
FLUID DYNAMICS	
Computational Methods and Applications in Fluid Dynamics	W81-70001
505 31 11 Liquid-Chemical Propulsion Technology	W81 70180
506 52 12 Global Weather Research	W81 70331
146 30 02 Fusion Target Technology Study	W81 70369
179 20 57	W81 70369
FLUID FLOW	
Combustion Technology for Power Generation	W81 70304
778 45 12	W81 70304
FLUID MECHANICS	
Validation of Stirling Lab Engine	W81 70308
778 46 35	W81 70308
FLUID MECHANICS	
Aeronautics Flight Experiments	W81 70009
505 31-44 Aerodynamic Test Methods and Instrumentation	W81 70010
505 31-51 Computational Fluid Mechanics for Turbomachinery	W81 70025
505 32-52 Graduate Research Program in Aeronautics	W81 70110
505 36-22 Aviation Safety Technology Applied Fluid Mechanics	W81-70110
505 44-25	W81-70110
FREE RADICALS	
Ultraviolet Spectroscopy of Planetary Atoms and Molecules	W81-70469
154 70-80	W81-70469
FREQUENCIES	
Communication Satellite Application Systems	W81-70377
643-10-02 Systems Coordination Support	W81-70379
643-10-03 Shuttle Time and Frequency Transfer Experiment (STIFT)	W81-70178
676-59-41	W81-70409
FREQUENCY ASSIGNMENT	
Technical Consultation Services	W81 70375
643-10-01 Technical Consultation Services	W81-70376
643-10 01	W81-70376

FREQUENCY DISTRIBUTION

Remote Sensing Frequency Coordination Studies
643-10-04 W81 70380

FREQUENCY DISTRIBUTION

Precision Time and Frequency Sources
310-10-42 W81 70574

FREQUENCY STABILITY

X-Band Uplink Development
310-20-64 W81 70583

FREQUENCY STANDARDS

Precision Time and Frequency Sources
310-10-42 W81 70574

FREQUENCY SYNCHRONIZATION

Frequency and Timing Research
310-10-62 W81 70577

FROST

Aviation Meteorology Research - Basic Atmospheric Processes
505-44-19 W81 70106

FUEL CELLS

Electrochemical Energy Conversion and Storage
506-55-52 W81 70236

Orbital Energy Storage and Power Systems (H2/O2)
506-55-57 W81 70238

Regenerative Fuel Cell/Electrolysis
Cell Hydrogen/Halogen
776-91-17 W81 70299

Advanced Energy Technology for Utilities
778-50-29 W81 70315

FUEL COMBUSTION

Graduate Research Program in Aeronautics
505 36-22 W81 70067

FUEL CONSUMPTION

General Aviation Aircraft Aerodynamics and Flight Dynamics
505 41 18 W81 70072

Advanced General Aviation Propulsion Research
505 41 22 W81 70073

Low Speed Propeller Research
505 41 52 W81 70076

Commercial Aircraft Fuel Savings
505 44 32 W81 70115

Long Haul Transport Aircraft Systems Studies
530 04-13 W81 70130

Advanced Rotorcraft Propulsion Technology
532 06 12 W81 70141

SRC - Aerodynamic Performance Technology
533 01-43 W81 70147

Laminar Flow Control
534-01-13 W81 70157

Energy Efficient Transport Wind Tunnel Testing
534-02-11 W81 70159

Energy Efficient Transport
534-02-13 W81 70160

Energy Efficient Transport Flight Research
534-02-14 W81 70161

Energy Efficient Engine Project
535-01 12 W81 70167

Advanced Turboprop Flight Research
535 03-14 W81 70171

FUEL FLOW

Flight Research Instrumentation Development
505 31 54 W81 70012

FUEL INJECTION

Hypersonic Propulsion Research
505 32 93 W81 70030

Combustion Technology for Power Generation
778-45 12 W81 70304

FUEL TANKS

Fuel Tank Sealants
533 01 11 W81 70143

FUEL-AIR RATIO

Advanced Low Emission Combustor (ALEC)
511 55 12 W81 70121

FUNCTIONAL ANALYSIS

Space Mission Uplink Process Control Architecture
540 01 15 W81 70278

FUSELAGES

General Aviation Crash Dynamics
505 41 33 W81 70074

Advanced Turboprop -Interior Noise
535 03 13 W81 70170

FUSION (MELTING)

Electrostatic Control & Manipulation of Materials for Containerless Processing
179 20 56 W81-70368

Fusion Target Technology Study
179 20 57 W81 70369

FUSION WELDING

Commercial Prototype Fusion Welding System
(Computer Controlled/Closed Circuit Television Arc Guidance)
141 95-01 W81-70318

G

GALACTIC EVOLUTION

Formation Evolution and Stability of Proto Stellar Disks
153 01-60 W81-70446

Theoretical Studies of Galaxies Active Galactic Nuclei and Quasi Stellar Objects
188-41-51 W81-70503

GALACTIC RADIATION

Infrared and Radio Astronomy
188 41 55 W81 70505

High Energy Astrophysics Data Analysis
389 46 01 W81 70562

GALACTIC STRUCTURE

Gamma Ray Astronomy
188 46-57 W81 70511

GALAXIES

Theoretical Studies of Galaxies Active Galactic Nuclei and Quasi Stellar Objects
188 41 51 W81 70503

GALILEO PROJECT

High Speed Data Transfer X/S Band Components
506-61 25 W81 70251

Planetary & Solar Spacecraft Systems Automated Optical Navigation
506-62 55 W81 70265

GALLIUM ARSENIDES

Solar Cell Technology
506-55 42 W81-70233

Solar Cell Research
506-55 43 W81 70234

Planetary Solar Array Research and Technology
506-65 45 W81 70235

GAMMA RAY ASTRONOMY

Gamma Ray Astronomy
188 46 57 W81 70510

Theoretical High Energy Astrophysics
389 46-03 W81 70563

GAMMA RAY SPECTRA

Gamma Ray Astronomy
188 46-57 W81 70511

GAMMA RAY SPECTROMETERS

Instrument Definition
157 03-01 W81 70487

GAMMA RAY TELESCOPES

Gamma Ray Astronomy
188 46-57 W81 70511

GAMMA RAYS

Remote Sensing
153 07-40 W81 70452

X-Ray Gamma-Ray and Neutron Gamma Ray Methods for Planetary Exploration
157 03 50 W81 70489

Ground Based Observations of the Sun
170-38 52 W81 70497

Particle Astrophysics
188-46 56 W81 70508

GANYMEDE

Extended Atmospheres
154-80 80 W81 70475

GAS ANALYSIS

Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere
147 10 02 W81 70355

Planetary Atmosphere Experiment Development
154 90 80 W81 70477

GAS CHROMATOGRAPHY

Planetary Atmospheric Composition and Structure
154 10-80 W81 70457

GAS COMPOSITION

Laser Heterodyne Spectrometer (LHS) Brassboard
147 40-01 W81 70366

GAS DYNAMICS

Planetary Probe Technology
506 51 23 W81 70176

OEX Flight Data Analysis
506 51-31 W81 70177

GAS GIANT PLANETS

Planetary Dynamics
153 05 70 W81 70450

GAS LASERS

Multi Spectral Detectors and Sensors
506-54-46 W81 70211

Advanced Infrared Astronomy and Laboratory
Astrophysics
196-41 54 W81 70523

GAS MIXTURES

Post-Spill Liquid Hydrogen Behavior
505 31 70 W81 70014

GAS TUNGSTEN ARC WELDING

Commercial Prototype Fusion Welding System
(Computer Controlled/Closed Circuit Television Arc Guidance)
141-95 01 W81 70318

GAS TURBINE ENGINES

Combustion and Emissions Reduction Research
505-32 32 W81 70023

Advanced Low Emission Combustor (ALEC)
511-55 12 W81 70121

GAS TURBINES

Advanced Turboprop Program
535-03 12 W81 70169

Combustion Technology for Power Generation
778-45-12 W81 70304

Advanced Energy Technology for Utilities
778-50 29 W81 70315

GAS-LIQUID INTERACTIONS

Post-Spill Liquid Hydrogen Behavior
505 31-70 W81-70014

GAS-SOLID INTERACTIONS

Post-Spill Liquid Hydrogen Behavior
505-31 70 W81 70014

GASEOUS ROCKET PROPELLANTS

Laser Propulsion
506-55 19 W81 70229

GASES

Photophysics and Laser Diagnostics
506-54 41 W81 70207

Glass Research
179 80-30 W81 70373

GEARS

Power Transfer Research
505 32 42 W81 70024

Helicopter Transmission Technology
511 58 12 W81 70122

GELS

Glass Research
179 80-30 W81 70373

GENERAL AVIATION AIRCRAFT

Cockpit Avionics Generic
505 34 23 W81 70048

General Aviation Aerodynamic Performance Technology
505-41 11 W81 70070

General Aviation Aerodynamics and Handling Qualities
Technology
505-41 13 W81 70071

General Aviation Aircraft Aerodynamics and Flight
Dynamics
505-41 18 W81 70072

Advanced General Aviation Propulsion Research
505-41 22 W81 70073

General Aviation Crash Dynamics
505-41 33 W81 70074

General Aviation Propeller Noise Reduction
505 41 43 W81-70075

Low Speed Propeller Research
505 41 52 W81-70076

General Aviation Avionics and Control Technology
505 41 63 W81-70077

General Aviation Avionics and Controls
505 41 68 W81-70078

General Aviation - Single Pilot IFR Systems
505 41-73 W81 70079

General Aviation System Technology Studies
530 01 13 W81 70126

Propulsion Systems for Small Transports
530-04 12 W81 70129

General Aviation Advanced Avionics Systems
531-01 11 W81 70132

GEOBOTANY

Geobotanical Test Site Investigations
677-42 01 W81 70424

GEOCHEMISTRY

Coastal and Estuarine Dynamic Processes Research
146-40 15 W81 70341

Integrated Study of Continental Rift Systems
677 43 05 W81 70427

Planetary Materials Lunar Sample Analysis
152-01 40 W81 70442

Planetary Materials Laboratory and Analytical Studies
152 02 40 W81 70443

Experimental Studies
153 02-40 W81 70447

Petrology Lab
153 02 70 W81 70448

Planetary Synthesis
153 06 70 W81 70451

Remote Sensing
153-07 40 W81 70452

Mars Data Analysis Program
155-20 40 W81 70480

Mars Data Analysis Studies
155-20 70 W81-70481

MDAP Geology
155-50 01 W81-70485

X Ray Gamma Ray and Neut on Gamma-Ray Methods
for Planetary Exploration
157-03 50 W81-70489

GEOCHRONOLOGY

Planetary Materials Lunar Sample Analysis
152 01-40 W81-70442

GEODESY

Advanced Geodynamics Studies
676-59 30 W81-70405

GEODETIC COORDINATES

Image Processing Technology
310 40 46 W81-70593

GEODYNAMICS

Global Earth Dynamics and Structure
676 30 01 W81 70403

Advanced Geodynamics Studies
676 59-30 W81 70405

Laser/VLBI Propagation Medium Analysis
676 59 35 W81 70407

Laser/VLBI Propagation Medium Analysis
676-59 37 W81-70408

Crustal Modeling Using Satellite Potential Field Data
677 45-01 W81 70429

GEOIDS

Geopotential Field Models
676 40-01 W81 70404

Gravity Field Survey Mission (GRAVSAT) Phase B
Studies
677 29 04 W81-70415

SUBJECT INDEX

GEOLOGICAL FAULTS

Regional Crustal Deformation Modeling	W81 70402
676-10 10	
Tectonic Structure in Pakistan	W81 70426
877-43 03	
Integrated Study of Continental Rift Systems	W81 70427
677-43 05	
Pipeline/Nuclear Plant Engineering Geology	W81-70428
677 44 01	

GEOLOGICAL SURVEYS

Terrain Models for SAR Development	W81 70425
677-43 01	

GEOLOGY

ADS Pilot Geosciences Information Network Development	W81 70396
656-13 70	
Radar Spectrometer	W81 70414
677-27 04	
NASA/Geosat Test Case Study	W81 70418
677 41 02	
Rock Type/Microwave Techniques (Imaging Radar Geology)	W81 70419
677 41 04	
Analysis of Multifrequency/Multipolarization SAR Imagery	W81 70423
677 41 12	
Terrain Models for SAR Development	W81 70425
677 43 01	
Pipeline/Nuclear Plant Engineering Geology	W81 70428
677 44 01	

GEOGRAPHY

Pioneer 6 11 Plasma Data Analysis	W81 70556
385 36 01	

GEOMORPHOLOGY

Alaska Wetlands Delineation Program	W81 70412
677 21-22	

GEOPHYSICS

Global Weather Research	W81 70331
146-30 02	
ADS Pilot Geosciences Information Network Development	W81-70396
656 13-70	
Regional Crustal Deformation Modeling	W81-70402
676-10 10	
Integrated Study of Continental Rift Systems	W81 70427
677 43 05	
Crustal Modeling Using Satellite Potential Field Data	W81 70429
677-45-01	
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies	W81-70430
677-45-03	
Mars Data Analysis Studies	W81-70430
155 20-70	
X-Ray Gamma-Ray and Neutron Gamma Ray Methods for Planetary Exploration	W81-70481
157-03-50	
Data Analysis Space Plasma Physics	W81 70557
385-36-02	

GEOPOENTIAL

Geopotential Field Models	W81-70404
676-40-01	

GEOS SATELLITES (ESA)

Ocean Circulation and Topography	W81 70337
146-40 07	

GERMANIUM

Gamma-Ray Astronomy	W81 70511
188-46-57	

GLASS

Refining of Nonterrestrial Materials	W81-70191
506-53 17	
Glass Research	W81 70373
179-80-30	

GLOBAL AIR POLLUTION

Upper Atmosphere Research Theoretical Studies	W81 70360
147-30 01	

GRADIENTS

Superconducting Gravity Gradiometer	W81 70406
676 59 33	

GRAND TOURS

Far Outer Planets Spacecraft Technology Definition	W81 70282
540-02 15	

GRANTS

Funds for Independent Research (Aeronautics)	W81 70061
505 36 11	
Fund for Independent Research (Aeronautics)	W81 70062
505 36 12	
Fund for Independent Research (Aeronautics)	W81 70063
505-36 13	
Funds for Independent Research	W81 70064
505-36 14	

GRAPHITE

Large Space Structure System Engineering	W81 70598
906 55 00	

GRAPHITE-EPOXY COMPOSITE MATERIALS

Fatigue Damage and Environmental Effects in Metals and Composites	W81 70033
505 33 21	

GRAVIMETRY

Geopotential Field Models	W81-70404
676 40 01	
Utilization of Space for Science Experiments	W81-70249
506 56-29	
Superconducting Gravity Gradiometer	W81 70406
676 59-33	
Mars Data Analysis Studies	W81 70481
155 20-70	

GRAVITATIONAL COLLAPSE

Formation Evolution and Stability of Proto-Stellar Objects	W81-70446
153 01-60	

GRAVITATIONAL FIELDS

Geopotential Field Models	W81-70404
676 40-01	
Gravity Field Survey Mission (GRAV-SAT) Phase B Studies	W81-70415

GRAVITY ANOMALIES

Crustal Modeling Using Satellite Potential Field Data	W81 70429
677 45-01	

GRAVITY GRADIOMETERS

Superconducting Gravity Gradiometer	W81 70406
676-59-33	

GREAT LAKES (NORTH AMERICA)

Great Lakes Water Quality Research	W81-70343
146 40-18	

GROOVING

Aircraft Landing Systems Efficiency Improvements	W81-70116
505-44-33	

GROUND EFFECT

Aerodynamics of Ground Vehicles	W81 70316
141-20 11	

GROUND SPEED

Aviation Operations Safety Technology - Wind Shear and Collision Avoidance	W81-70112
188-44-28	

GROUND STATE

Theoretical Infrared and Radio Astrophysics	W81 70506
188-41-55	

GROUND STATIONS

Spacelab 2 Superfluid Helium Experiment	W81 70291
542 03 13	

GROUND SUPPORT EQUIPMENT

Astronomical Optical Instrument Development	W81 70530
196 41 81	

GROUND SUPPORT SYSTEMS

High Performance Aircraft Flight Test Support	W81 70151
533 Q2 24	

GULF STREAM

Coastal and Estuarine Dynamic Processes Research	W81 70342
146 40 15	

GUN PROPELLANTS

NASA Ames Research Center Vertical Gun Facility	W81-70455
153 08 60	

H

H LINES

UV and Optical Astronomy	W81 70501
188 41-51	

HALOGENS

Regenerative Fuel	W81 70299
Cell Hydrogen/Halogen	
776 91-17	

HARDWARE

Advanced Carbon-Carbon Stand Off Panel	W81-70197
506 53-37	

HARRIER AIRCRAFT

AV 8A V/STOL Flight Experiments	W81 70089
505-42-74	

HAULING

Heavy-Lift/Short Haul Hybrid Airship Technology	W81 70086
505-42-51	

HAWAII

Geological Mapping Kilauea Caldera Stratigraphy	W81-70421
677-41-09	

HAZARDS

Post Spill Liquid Hydrogen Behavior	W81 70014
505-31-70	

HAZARD STUDIES

Advanced Manned Vehicle Onboard Propulsion Technology	W81-70181
506-52-17	

HAZARD STUDIES

Pipeline/Nuclear Plant Engineering Geology	W81-70428
677-44 01	

HELICOPTERS

HAZE

Radiative Transfer in Cloudy Atmosphere	W81-70464

Rotorcraft Aerodynamic Performance Dynamics and Handling Qualities	Application of Flight Simulation Technology	Seasat Digital SAR Processing (Non-Renewable Resources)
505 42 21 Rotorcraft Aerodynamics Scale Modeling	505 35-33 Space Engineering	677-48 01 W81 70435
505 42 23 Advanced Rotor Systems Technology/RSRA Operations	506-53-10 Human Reactions	Data Analysis Astronomy
532 03 11	505 35-13 Human Response to Noise	389-41-01 W81 70561
HELIUM	HYDROCARBON FUELS	Image Processing Technology
Spacelab 2 Superfluid Helium Experiment	Fuels Research	310-40 46 W81 70593
542 03 13	505-32 72 Hypersonic Propulsion Research	IMAGE RESOLUTION
HEMATOLOGY	505-32-93 Broad Property Fuels Technology	Terrain Models for SAR Development
Blood Alterations (Influence of Space Flight on the Blood Forming Tissues)	511 59-12 Liquid-Chemical Propulsion Technology	677-43 01 W81 70425
199 20 50	506 52-12 Advanced Manned Vehicle Onboard Propulsion Technology	Seasat Digital SAR Processing (Non-Renewable Resources)
HIGH ALTITUDE BALLOONS	506 52-17	677-48 01 W81 70435
Airborne Experiment Platforms	HYDROCARBONS	Seasat Digital SAR Processing (Renewable Resources)
530 02 18	Advanced Reusable Main Engine Technology	677-76-01 W81 70436
Infrared and Radio Astronomy	506 52 19 NASA/Geosat Test Case Study	IMAGERY
188-41 55	677 41 02 Aeronomy of Planetary Atmospheres	Imaging Studies of Comets
HIGH ENERGY PROPELLANTS	154 75 80 Chemistry	196-41 52 W81 70522
High Energy Chemical Propulsion Technology for Planetary Spacecraft	HYDRODYNAMICS	Advanced Synthetic Aperture Radar Technology
506 52 25	Formation Evolution and Stability of Proto-Stellar Disks	506-61 37 W81 70257
W81 70183	153 01 60	Microscale Ocean Surface Dynamics
HIGH POWER LASERS	HYDROGEN	146-40 05 W81 70333
Advanced Radiant Energy Conversion	Advanced Reusable Main Engine Technology	Ocean Wave Height Determination with the Synthetic Aperture Radar
506 55 13	506 52 19 Regenerative Fuel Cell/Electrolysis	146-40-05 W81 70334
W81 70227	Cell Hydrogen/Halogen	Remote Sensing of Air Sea Interactions Phenomena
HIGH RESOLUTION	776 91 17 Shuttle Time and Frequency Transfer Experiment (STIFT)	146-40 05 W81 70335
Atomic & Molecular Properties of Planetary Atmospheric Constituents	676 59 41 Post-Spill Liquid Hydrogen Behavior	Automated Mosaicking for Geocoded Data Bases
154 50 80	505 31 70	656-33-01 Tectonic Structure in Pakistan
X Ray Timing Explorer (XTE)	HYDROGEN OXYGEN ENGINES	677-43 03 W81 70426
685 20 11	Liquid-Chemical Propulsion Technology	Radar Studies
W81 70567	506 52 12	153-07 70 W81 70453
HIGH SPEED	506 52 19	Clouds Particulates and Ices
V/STOL Systems Technology	Regenerative Fuel Cell/Electrolysis	154 30 80 W81 70463
532 05 11	Cell Hydrogen/Halogen	Fiber Optically Mosaiced Large Area Image Sensors
HIGH TEMPERATURE	776 91 17	188 41 54 W81 70504
Loads Dynamics and Aeroelasticity	Shuttle Time and Frequency Transfer Experiment (STIFT)	Gamma Ray Astronomy
506 53 64	676 59 41 Post-Spill Liquid Hydrogen Behavior	188 46 57 W81 70510
Solar Cell Research	505 31 70	Sounding Rocket Experiments (High Energy Astrophysics)
506 55 43	HYDROGEN CLOUDS	879 11 46 W81 70570
Advanced Containerless Processing Technology	Post-Spill Liquid Hydrogen Behavior	IMMUNOLOGY
179 20 55	505 31 70	Bioseparation
W81 70367	HYDROGEN OXYGEN ENGINES	179 80 80 W81 70374
HIGH TEMPERATURE ENVIRONMENTS	Liquid-Chemical Propulsion Technology	IMPACT DAMAGE
High Temperature Structures	506 52 12	Composites
505-33 72	506 52 19	505 33 33 NASA Ames Research Center Vertical Gun Facility
W81 70045	Regenerative Fuel Cell/Electrolysis	153 08 60 W81 70455
HIGH TEMPERATURE GASES	Cell Hydrogen/Halogen	IMPACT RESISTANCE
Sounding Rockets Experiment	776 91 17	Life Prediction for Composite Materials
828 11 38	Shuttle Time and Frequency Transfer Experiment (STIFT)	505 33 23 Composites for Propulsion Components
W81 70569	676 59 41 Post-Spill Liquid Hydrogen Behavior	505 33 32 General Aviation Crash Dynamics
HIGH TEMPERATURE RESEARCH	505 31 70	505 41 33 W81 70074
SCR Materials and Structures Flight Research	HYDROLOGY	INDUSTRIAL ENERGY
533-01-14	Coastal and Estuarine Dynamic Processes Research	Coal Conversion Processes and Systems
W81 70145	146-40 15	778 47 29 W81 70310
HIGH VOLTAGES	HYDROXYL RADICALS	Industrial Conservation Cogeneration and Utilization of Alternative Fuels
Multi KW Low Cost Earth Orbital Systems	Theoretical Infrared and Radio Astrophysics	778-49 15 W81 70313
506 55-79	188-41 55	INDUSTRIAL WASTES
W81 70243	HYPERSONIC AIRCRAFT	Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring
HIGHWAYS	High Temperature Aeronautical Structures	146 20 10 W81 70328
Concepts for Improved Ground Transportation Systems	505-33 73	INELASTIC SCATTERING
778 48-15	W81 70046	Aeronomy Energy Deposition
W81 70311		154-70 80 W81 70470
HOLOGRAPHY		INFORMATION DISSEMINATION
Aerodynamic Test Methods and Instrumentation		Chemical Propulsion Research Support
505-31-51		506 52 30 W81 70184
W81 70010		Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame
HORMONES	ICE	540 01 16 W81 70279
Fluid and Electrolyte Change	Advanced Ocean Sensor Systems Development	OSTA Data Systems Standards and Guidelines
199 20-60	146-40 13	656 13 10 W81-70390
W81 70540		Applications Data Service (ADS) Atmospheric Pilot System
HPSEPOWER	ICE FORMATION	656 13 30 W81 70393
Solar Rankine Cycle Applications Study	Aviation Meteorology Research	Solar Physics Data Analysis and Operations
776-91-59	505 44-12	385 38-01 W81 70559
W81 70303	Aviation Meteorology Research Severe Storms	High Energy Astrophysics Data Analysis
HOT CORROSION	505 44-13	389 46 01 W81 70562
Metallic/Ceramic Materials	Knowledge of High Altitude Atmospheric Processes	Theoretical High Energy Astrophysics
505-33 12	505 44-14	389 46 03 W81 70563
W81 70031	Advanced Rotorcraft Propulsion Technology	INFORMATION MANAGEMENT
HOT-WIRE ANEMOMETERS	532-06-12	Chemical Propulsion Research Support
Aerodynamics of Ground Vehicles	W81 70141	506 52-30 W81 70184
141 20 11	Microwave Remote Sensing for Ice Processes Research	Information Systems for Earth Observations for Space
W81 70316	146-40-06	540 01-13 W81 70277
HOVERING	W81 70336	INFORMATION RETRIEVAL
V/STOL Propulsion Research		Data Reproduction in Support of the Mars Data Analysis Program
505-42 62	ICE MAPPING	155 50-01 W81 70484
W81 70087	Climate Research	
HOVERING STABILITY	146-10 03	
Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research	W81 70324	
505-42 71		
W81 70088	IDEAL GAS	
	Space Vehicle Aerothermodynamics and Configuration Technology	
HUMAN FACTORS ENGINEERING	506 51-13	506 52 30 W81 70184
Cockpit Avionics Generic	W81 70174	Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame
505-34-23		540 01 16 W81 70279
W81 70048		OSTA Data Systems Standards and Guidelines
Human Response to Noise		656 13 10 W81-70390
505-35 13		Applications Data Service (ADS) Atmospheric Pilot System
W81 70055		656 13 30 W81 70393
Flight Management Systems		Solar Physics Data Analysis and Operations
505-35 21		385 38-01 W81 70559
W81 70056		High Energy Astrophysics Data Analysis
Crew Interaction with Advanced Flight Systems	506 56 16	389 46 01 W81 70562
505-35 23	W81 70247	Theoretical High Energy Astrophysics
W81 70057		389 46 03 W81 70563
Human Factors Flight Research with High Performance Aircraft and RPVs	IMAGE ENHANCEMENT	
505-35 24	Analysis of Multifrequency/Multipolarization SAR Imagery	
W81-70058	677-41 12	W81 70423
Simulation Technology for Aeronautics	146 40 15	
505-35 31	Systems for Underwater Survey and Exploration (SUSE)	
W81-70059	637 01 02	W81 70381
Man-Machine Engineering Requirements for Data and Functional Interfaces	Automated Mosaicking for Geocoded Data Bases	656 33 01 W81 70398
199-60 71	656 45-02	Registration of Radar and Other Data
W81-70544	W81 70399	656 45-02 W81 70400
Operations Support Computing Technology	W81 70423	Synthetic Aperture Radar Processor
310 40 26	656 62 01	Tectonic Structure in Pakistan
W81-70590	677 43 03	677 43 03 W81 70426
HUMAN PATHOLOGY		
Bioseparation		
179 80 80		
W81-70374		
HUMAN PERFORMANCE		
Crew Interaction with Advanced Flight Systems		
505 35-23		
W81-70057		

NASA End to End Data System (NEEDS) Phase 2	506-61-56	W81 70262	INFRARED SCANNERS	Shuttle Infrared Leeside Temperature Sensing (SILTS)	506-63 34	W81-70273	INTERFERENCE DRAG	General Aviation Aerodynamic Performance Technology
Information Systems for Earth Observations for Space	540 01-13	W81-70277		Aircraft Thermal Infrared Scanner	677-47 01	W81-70432	505-41 11	W81 70070
Ground Data Processing Technology Options Assessment							INTERFERENCE LIFT	Propulsion System Integration
for Missions of the 1985 1990 Time Frame	540-01-16	W81-70279					505-32 13	W81 70021
ADS Pilot Geosciences Information Network	656-13-70	W81-70396	INFRARED SPECTRA	Atomic & Molecular Properties of Planetary Atmospheric Constituents	154 50 80	W81 70465	INTERFEROMETERS	Radio Astronomy
Development	310 40-46	W81-70593		154 50 80	196 41 77	W81 70527	188-41-55	W81-70507
Image Processing Technology	310-40 72	W81-70595	INFRARED SPECTROMETERS	Planetary Infrared Imaging	196 41 77	W81 70527	Ground-Based Infrared Astronomy	196 41-50
Network Data Processing Development							Astronomical Optical Instrument Development	196 41-81
			INFRARED SPECTROSCOPY	Multi Spectral Detectors and Sensors	506 54 46	WB1 70211	Remote Sensing Of Planetary Surfaces	WB1-70530
				Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere	147 20 03	WB1 70359		
				Ground-Based Infrared Astronomy	196 41-50	WB1 70520		
				Advanced Infrared Astronomy and Laboratory Astrophysics	196 41 54	WB1 70523		
				Infrared Astronomy	196 41-72	WB1 70526		
			INFRARED TELESCOPES	Space System Studies Information and Spacecraft Systems	540 02-11	WB1 70280		
				Development of Shuttle Infrared Telescope Facility (SIRTF)	358-41 06	WB1 70551		
				Aerodynamics of Ground Vehicles	141-20-11	WB1 70316		
			INGESTION (ENGINES)	141-20-11	WB1 70316			
				Graduate Research Program in Aeronautics	506-52 19	WB1-70182	INJECTORS	Advanced Reusable Main Engine Technology
				High Performance Aircraft Airframe Propulsion Integration	505-32 03	WB1-70018		
			INLET FLOW	Propulsion Noise Research	505-36 22	WB1-70067		
				Graduate Research Program in Aeronautics	505-43 21	WB1-70093		
			INLET NOZZLES	Inlet Nozzle and Propeller Research	505-32 13	WB1 70020		
				Propulsion System Integration	505-42 62	WB1 70021		
				V/STOL Propulsion Research	505 34 23	WB1 70087		
			INPUT/OUTPUT ROUTINES	Cockpit Avionics Generic	154 20 80	WB1 70048		
				Dynamics of Planetary Atmospheres	505 34 23	WB1 70460		
			INSOLATION	154 20 80	WB1 70460			
			INSTRUMENT FLIGHT RULES	General Aviation Avionics and Controls	505 41 68	WB1 70078		
				General Aviation Single Pilot IFR Systems	505 41 73	WB1 70079		
			INSTRUMENT LANDING SYSTEMS	Rotorcraft Operating Systems Technology	532 01-11	WB1 70133		
			INSTRUMENT ORIENTATION	Instrument Pointing Systems	506 61 43	WB1 70258		
			INSTRUMENT PACKAGES	Sensor Cooling System	506 61-46	WB1 70259		
				ACIP (Aerodynamic Coefficient Identification Package)	506-63-27	WB1-70270		
				Infrared Imagery of Shuttle	506-63 35	WB1 70274		
				Sounding Rocket Experiments (High Energy Astrophysics)	879-11 46	WB1-70570		
			INTAKE SYSTEMS	Inlet Nozzle and Propeller Research	505-32 12	WB1-70020		
				Propulsion System Integration	505-32 13	WB1 70021		
				V/STOL Propulsion System Technology	532-05 12	WB1-70140		
			INTEGRATED CIRCUITS	Propulsion System/Airframe Integration Technology	533 01 62	WB1-70148		
				SCR Airframe/Propulsion System Interactions	533-01 63	WB1-70149		
			INTEGRATED OPTICS	Signal Processing and Detection High Density Circuit Technology	506 54 59	WB1 70214		
				High Speed Signal Processing Research	310 30 70	WB1-70589		
			INTEGRATED OPTICS	Data Transmission and Processing Research	506 54 55	WB1-70212		
				Advanced Electronic Components	506 54 63	WB1 70216		
				Network Systems Technology Development	310 20 33	WB1 70580		
			INFRARED RADIOMETERS	Planetary Atmospheric Composition and Structure				
				154-10-80				
				Cosmic Background Explorer (COBE)				
				685 20-08				
				Planetary Atmospheric Composition and Structure				
				154-10-80				

ION RECOMBINATION

SUBJECT INDEX

SUBJECT INDEX

LIFE (DURABILITY)	LIQUID-SOLID INTERFACES	MAGNETOSPHERE
Propulsion Instrumentation Research	Development of a Shuttle Flight Experiment Drop	M
505 32-82	Dynamics Module	
Fatigue Damage and Environmental Effects in Metals	542-03 01	W81 70289
and Composites	906-55 00	
505 33-21	Large Space Structure System Engineering	W81 70598
Life Prediction	W81 70598	
505 33-22	LITHIUM	
Turbine Engine Hot Section Technology (HOST)	Global Earth Dynamics and Structure	906 55-00
510 57-12	676-30 01	W81 70405
Advanced Nickel Cadmium and Lithium Batteries	Geopotential Field Models	677-45 01
506-55-55	676-40 01	Petrologic and Geophysical Studies of the Source of Long
Orbital Energy Storage and Power Systems (H2/O2)	LOAD DISTRIBUTION (FORCES)	Wavelength Crustal Magnetic Anomalies
506-55-57	Configuration Aerodynamics	677-45 03
	505 31 43	W81 70430
	Space Vehicle Dynamics	Magsat Correlative Studies
	506 53 69	677-45-04
	LOADS (FORCES)	W81 70431
	Loads Dynamics and Aeroelasticity	
	505 33-52	W81 70454
	SCR Materials and Structures	
	533 01 13	MAGNETIC EFFECTS
	Composites for Advanced Space Systems	Advanced Geodynamics Studies
	506 53-23	153-08-50
	Loads Dynamics and Aeroelasticity	W81 70206
	506 53-64	
	LOGIC DESIGN	W81-70454
	Aircraft Controls Reliability Enhancement	
	505-34-31	MAGNETIC FIELDS
	LOGISTICS MANAGEMENT	Signal Detection and Processing
	JSC General Operations Support	Filters and Receivers
	152-05-40	506-54-56
	Planetary Materials	Geopotential Field Models
	W81 70445	676 40-01
	LONG DURATION EXPOSURE FACILITY	Advanced Geodynamics Studies
	Long Duration Exposure Facility	676-59 30
	542 04 13	Extended Atmospheres
	LONG TERM EFFECTS	154-80-80
	Extended Atmospheres	Particles and Particle/Field Interactions
	154 80 80	170 36 55
	LONGITUDINAL CONTROL	Data Analysis Space Plasma Physics
	Advanced Turboprop Program	385-36 02
	535 03 12	W81 70557
	LOW ALTITUDE	MAGNETIC MATERIALS
	Aviation Meteorology Research Atmospheric Dynamics	Aircraft Controls Electromechanical Actuator
	& Measurement Tech	Technology
	505 44 18	505 34 37
	LOW GRAVITY MANUFACTURING	W81 70053
	Advanced Containerless Processing Technology	MAGNETIC PROPERTIES
	179 20 55	Petrologic and Geophysical Studies of the Source of Long
	LOW SPEED	Wavelength Crustal Magnetic Anomalies
	V/STOL Systems Technology	677 45 03
	532 05 11	W81 70430
	LUBRICANTS	MAGNETIC SIGNATURES
	Power Transfer Research	Experimental Magnetism
	505 32 42	153 08 50
	Materials Science	Ground-Based Observations of the Sun
	506-53-12	170-38-52
	Tribological Experiments in Zero Gravity	Data Analysis Solar Physics
	542 03-27	385 38-01
	LUBRICATION SYSTEMS	W81 70560
	Power Transfer Research	MAGNETIC SUSPENSION
	505 32-42	Experimental Methods and Instrumentation
	LUNAR BASES	505 31 53
	Refining of Nonterrestrial Materials	Instrument Pointing Systems
	506 53 17	506-61 43
	LUNAR EVOLUTION	W81 70258
	Planetary Materials Lunar Sample Analysis	MAGNETIC TAPES
	152 01 40	Fundamentals of Mechanical Behavior of Composites
	Planetary Materials Laboratory and Analytical Studies	Matrices
	152 02 40	506-53 15
	LUNAR MAPS	W81-70190
	Remote Sensing	MAGNETIZATION
	153-07 40	Petrologic and Geophysical Studies of the Source of Long
	Remote Sensing Of Planetary Surfaces	Wavelength Crustal Magnetic Anomalies
	196 41 40	677 45-03
	LUNAR ORBITS	W81 70430
	Earth Based Solar System Observations	Experimental Magnetism
	196 41 78	153-08 50
	LUNAR ROCKS	W81 70454
	Refining of Nonterrestrial Materials	MAGNETOHYDRODYNAMIC FLOW
	506 53-17	Extended Atmospheres
	Planetary Materials Lunar Sample Analysis	154-80-80
	152 01-40	W81-70475
	Planetary Materials Laboratory and Analytical Studies	MAGNETOHYDRODYNAMIC GENERATORS
	152 02-40	Advanced Energy Technology
	Curation of Extraterrestrial Samples	506-55 15
	152-04-40	Advanced Energy Technology for Utilities
	LUNAR SOIL	778 50 29
	Refining of Nonterrestrial Materials	MAGNETOHYDRODYNAMIC STABILITY
	506-53 17	Planetary Aeronomy Theory and Analysis
	Planetary Materials Lunar Sample Analysis	154 60 80
	152 01 40	W81 70467
	Planetary Materials Laboratory and Analytical Studies	MPD Thruster System Technology
	152-02 40	506 55 35
	Curation of Extraterrestrial Samples	W81 70232
	152-04 40	MAGNETOSPHERE
	LUNAR SURFACE	Planetary Aeronomy Theory and Analysis
	Theoretical Studies of Radar Backscatter	154 60 80
	677-41 11	Extended Atmospheres
	Remote Sensing Of Planetary Surfaces	154 80-80
	196 41 40	Magnetospheric Physics Particles and Particle/Field
	LYMPHOCYTES	Interaction
	Bioseparation	170 36-55
	179 80-80	Particles and Particle/Field Interactions
		170-36 55
		Particle and Particle/Photon Interactions
		(Atmospheric Magnetospheric Coupling)
		170-36-56
		Particle Accelerator Facility Maintenance and Operation
		of a Calibration Facility for Magnetospheric and
		Solar Terrestrial Experiments
		170 36 57
		Origins of Plasma in the Earth's Neighborhood (OPEN)
		171-03 00
		Radio and Radar Planetary Studies
		196 41 51
		Atmosphere-Ionosphere-Magnetosphere Interactions
		385 36 01
		Magnetospheric Data Analysis
		385 36-01
		Data Analysis Space Plasma Physics
		385 36 02
		Energetic Particles and Plasmas in the Magnetospheres
		of Jupiter and Saturn
		385 36-04

Sounding Experiments	Rockets	Magnetospheric Physics	Planetary Synthesis	W81 70451	Space Shuttle Aerodynamic Experiments	W81 70179
828 11 36		W81 70568	153-06 70		506 51 34	
MAGSAT A SATELLITE			Earth Based Solar System Observations	W81 70528	Space Vehicle Dynamics	W81 70206
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies		W81 70430	196 41 78		506 53 69	
677 45-03			MARINE ENVIRONMENTS		Severe Storms and Local Weather Research	
Magsat Correlative Studies		W81-70431	Coastal and Estuarine Dynamic Processes Research	WB1-70341	146-50 02	
677 45 04			146 40 15		Regional Crustal Deformation Modeling	W81 70344
MAGSAT SATELLITES			MARINER 10 SPACE PROBE		678 10 10	
Advanced Geodynamics Studies		W81 70405	Clouds Particulates and Ices	WB1-70341	Global Earth Dynamics and Structure	W81 70402
676 59-30			154 30 80	WB1 70463	676 30 01	
MAINTENANCE			MARINER 9 SPACE PROBE		Geopotential Field Models	W81 70403
Station Monitor and Control Technology		W81 70587	Mars Data Analysis	WB1 70478	676 40 01	
310 30-68			155 04 80		Theoretical Studies of Radar Backscatter	W81 70404
MAN MACHINE SYSTEMS					677 41 11	
Flight Management Systems		W81-70056	MARKET RESEARCH		Integrated Study of Continental Rift Systems	
505 35 21			Low Speed Aircraft Systems Studies	WB1 70127	677 43 05	
Crew Interaction with Advanced Flight Systems		W81 70057	530 02 11		Crustal Modeling Using Satellite Potential Field Data	W81 70427
505 35 23			Long Haul Transport Aircraft Systems Studies	WB1 70130	677 45-01	
Human Factors Flight Research with High Performance Aircraft and RPVs		W81 70058	530 04 13		Theoretical Studies of Planetary Bodies	W81 70441
505 35-24			MARS (PLANET)		151 02 60	
Application of Flight Simulation Technology		W81 70060	Planetary Dynamics	WB1 70450	154 60 80	
505 35 33			Mars Data Analysis Program	WB1 70480	Network Productivity Research	W81-70468
Automated Decision Making and Problem Solving		W81 70219	155-41 80	WB1 70482	310 40 73	
506 54 73			Data Reproduction in Support of the Mars Data Analysis Program	WB1 70484	MATRICES (CIRCUITS)	
Robotics/Machine Intelligence Automated Systems		WB1 70223	155-50 01		Satellite Switching and Processing Systems	
506 54 85			MARS ATMOSPHERE		650 60 21	
Man Machine Systems		W81 70591	Planetary Atmosphere Aeolian Processes on Planets	WB1 70439	MEASURING INSTRUMENTS	
199 60-60			151-01 60		Flight Research Instrumentation Development	
Man Machine Engineering Requirements for Data and Functional Interfaces		W81 70543	Dynamic Radiative Interaction	WB1 70461	505 31 54	
199-60 71			Aeronomy of Planetary Atmospheres	WB1 70472	Full Space Reynolds Number Test Technology	W81 70012
Advanced Teleoperation Studies		W81 70544	154-75 80		505 31 63	
199 60 80			Mars Data Analysis	WB1 70478	MECHANICAL PROPERTIES	
Human To-Machine Interface Technology		W81 70545	155 04 80	WB1 70479	Advanced Aluminum Alloys	
310 40 37			Planetary Atmospheres Data Analysis	WB1 70481	505 33 13	
MANAGEMENT			Mars Data Analysis Studies	WB1 70482	Interdisciplinary Research in Composite Structures	W81 70032
Concepts for Improved Ground Transportation Systems		W81 70311	155 20 70		505 33-60	
778-48 15				WB1 70483	Materials Science	W81 70042
MANAGEMENT INFORMATION SYSTEMS			MARS SURFACE		506 53 12	
Solar Physics Data Analysis and Operations		W81 70559	Planetary Geology Aeolian Processes on Planets	WB1 70439	Spacelab 2 Superfluid Helium Experiment	
385 38 01			151 01 60		542 03 13	
MANAGEMENT SYSTEMS			Planetary Geology	WB1 70440	Mars Data Analysis Program	W81 70291
Mission Operations Technology		W81 70592	151 01 70		155 20 40	
310 40-45			Theoretical Studies of Planetary Bodies	WB1 70441	MELTING	
MANEUVERABILITY			151 02 60		Interior Models	
AV 8A V/STOL Flight Experiments		W81-70089	Mars Data Analysis Program	WB1-70441	153 03 42	
505 42 74			155 20 40		MESOSCALE PHENOMENA	
Flight Vehicle Dynamics		W81 70090	Mars Data Analysis Studies	WB1 70480	Ocean Circulation and Topography	
505 43 11			155 20 70	WB1 70481	146 40 07	
Highly Maneuvering Aircraft Technology		W81 70156	Mars Data Analysis Program Geology	WB1 70483	Coastal and Estuarine Dynamic Processes Research	W81 70337
533 03-13			155 50 01		146 40 15	
MANIPULATORS			MDAP Geology	WB1 70485	Coastal and Estuarine Dynamic Processes Research	W81-70341
Intelligent Systems Research		W81 70222	155 50 01		146 40 15	
506 54-83				WB1 70483	Severe Storms and Local Weather Research	W81 70342
Robotics/Machine Intelligence Automated Systems		WB1-70223	MASERS		146 50-02	
506 54 85			Shuttle Time and Frequency Transfer Experiment (STIFT)	WB1-70409	Upper Atmosphere Research	
MANNED SPACE FLIGHT			676 59 41	WB1-70409	147 20 01	
Operational Laboratory Support		W81 70534	Radio Astronomy	WB1 70507	Upper Atmosphere Research	
199 10 10			188 41 55	WB1 70507	147 30 01	
Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection)		W81 70535	Precision Time and Frequency Sources	WB1 70547	Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere	W81-70360
199 10 20			310 10 42	WB1 70577	147 30 01	
Crew Health Maintenance		W81 70536	Frequency and Timing Research	WB1 70577	Stratospheric Research	W81 70362
199 10 30			310 10 62	WB1 70585	147 30 02	
Space Motion Sickness		W81-70538	Radio Systems Development	WB1 70585	MESOSPHERE	
199 20-00			310-20 66		Upper Atmosphere Research	
Blood Alterations (Influence of Space Flight on the Blood Forming Tissues)		W81 70539	MASS SPECTROMETERS		Measurements	
199-20 50			Shuttle Upper Atmospheric Mass Spectrometer (SUMS)	WB1 70276	147 20 01	
Fluid and Electrolyte Change		W81 70540	506 63 37	WB1 70276	Upper Atmosphere Research	
199 20 60			Instrument Development for Spaceflight Experiments	WB1-70488	147 30 01	
Radiation Effects and Protection RTOP		W81 70541	157 03 40		Stratospheric Research	W81 70362
199 20 70			Planetary Atmosphere Experiment Development	WB1 70477	147 30 02	
Man Machine Engineering Requirements for Data and Functional Interfaces		W81 70544	154 90 80	WB1 70477	MESOSCALE PHENOMENA	
199-60 71			Magnetospheric Data Analysis	WB1 70555	Ocean Circulation and Topography	
Interdisciplinary Research		W81 70544	385 36 01	WB1 70555	146 40 07	
199-90 71			MASS TRANSFER		Coastal and Estuarine Dynamic Processes Research	W81 70337
MANPOWER		W81 70547	Aerosol Climatic Effects Special Study		146 40 15	
Cost Analysis of Space Flight Systems within the Office for Space and Terrestrial Applications			146-10 04	WB1 70325	Coastal and Estuarine Dynamic Processes Research	W81-70341
146 90 03			Interior Models	WB1-70449	146 40 15	
MANUFACTURING			152 03 42	WB1 70449	Severe Storms and Local Weather Research	W81 70342
Interdisciplinary Research in Composite Structures		W81 70351	Planetary Aeronomy Theory and Analysis	WB1 70467	146 40 15	
505 33 60			154 60 80	WB1 70467	146 40 15	
Advanced Chemical Propulsion Concepts For Planetary Spacecraft		W81 70185	MATERIALS SCIENCE		Severe Storms and Local Weather Research	W81 70345
506 52-35			Materials for Advanced Turbine Engines (MATE)	WB1 70117	146 40 15	
MAPPING			510 53 12		146 40 15	
NASA/Geosat Test Case Study		W81-70418	MATHEMATICAL MODELS		Severe Storms and Local Weather Research	W81 70345
677 41 02			Turbulence and Modeling	WB1 70003	146 40 15	
Geological Mapping Kilauea Caldera Stratigraphy		W81 70421	505-31-21		146 40 15	
677 41 09			Loads Dynamics and Aeroelasticity	WB1 70039	146 40 15	
Geobotanical Test Site Investigations		W81 70424	505 33 52		146 40 15	
677 42-01			AV 8A V/STOL Flight Experiments	WB1-70089	146 40 15	
Tectonic Structure in Pakistan		W81 70426	505 42 74	WB1-70089	146 40 15	
677 43-03			Knowledge of High Altitude Atmospheric Processes	WB1 70103	146 40 15	
Crustal Modeling Using Satellite Potential Field Data		W81 70429	505 44 14	WB1 70103	146 40 15	
677 45 01			Aviation Safety Technology - Applied Fluid Mechanics	WB1 70110	146 40 15	
Magsat Correlative Studies		W81 70429	505 44-25		146 40 15	
677 45 04			V/STOL Propulsion System Technology	WB1 70110	146 40 15	
		W81 70431	532 05-12	WB1 70140	146 40 15	
			Computational and Experimental Aerothermodynamics	WB1 70173	146 40 15	
			506-51-11	WB1 70173	146 40 15	

SUBJECT INDEX

MICROCOMPUTERS	
Human To Machine Interface Technology	W81 70591
310-40-37	
Mission Operations Technology	W81 70592
310 40-45	
MICROELECTRONICS	
Aircraft Controls Flight Systems Concepts	W81 70052
505 34 34	
General Aviation Advanced Avionics Systems	W81 70132
531-01 11	
Signal Processing and Detection	High-Density Circuit Technology
Technology	W81 70214
506 54 59	
High Density Circuit Technology	Electronic Devices
506-54-60	W81 70215
MICROPROCESSORS	
Aeronautical Structural Design Methods	W81-70044
505 33 63	
Cockpit Avionics Generic	W81 70048
505 34-23	
Integrated Avionic Control Systems for Rotorcraft	W81 70085
505 42 31	
NASA End to End Data System (NEEDS) Data Base Management/Archival Mass Memory	W81 70263
506 61-59	
Commercial Prototype Fusion Welding System (Computer Controlled/Closed Circuit Television Arc Guidance)	W81 70318
141 95 01	
Very Low Cost Data System	16 Bit Microprocessor-Driven ELAS
677-76-04	W81-70437
Advanced Technological Development	General Signal and Data Processing Electronics
and Data Processing Electronics	Solid State Detectors
188 78-51	W81-70516
Altitude/Orbit Systems Technology	310 10-26
W81-70573	
MICROSTRUCTURE	
Advanced Aluminum Alloys	W81 70032
505 33 13	
Fundamental Electronics	W81-70217
506 54-65	
MICROWAVE AMPLIFIERS	
High Efficiency Technology for Microwave Amplifiers	W81-70250
506-61 22	
Satellite Communications Technology	W81 70287
541 02 12	
MICROWAVE ANTENNAS	
VLBI Development and Analysis	W81-70576
310-10-61	
MICROWAVE EQUIPMENT	
High Speed Data Transfer S/K-Band Components and Techniques	W81 70252
506-61 26	
Sensor Systems	W81 70256
506-61 36	
Remotely Sensed Electromagnetic Characteristics of Snow and Soil Moisture	W81 70413
677-22 12	
MICROWAVE FREQUENCIES	
Microscale Ocean Surface Dynamics	W81 70333
146-40 05	
Frequency and Timing Research	W81 70577
310 10 62	
MICROWAVE IMAGERY	
Rock Type/Microwave Techniques (Imaging Radar Geology)	W81 70419
677 41 04	
Earth Based Solar System Observations	W81 70528
196 41 78	
MICROWAVE PROBES	
Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	W81 70382
637 01 03	
MICROWAVE RADIOMETERS	
Microwave Technology Development for Atmospheric Turbulence Studies	W81 70104
505 44 15	
Sensor Systems Technology	W81-70254
506 61 33	
MICROWAVE SCATTERING	
Theoretical Studies of Radar Backscatter	W81 70422
677 41-11	
MICROWAVE SENSORS	
Sensor Systems	W81-70256
506 61-36	
Seasat Data Utilization Project	W81-70322
146 01-00	
Global Weather Research	W81-70330
146 30-02	
Remote Sensing Frequency Coordination Studies	W81-70380
643 10-04	
Extended Scene Radar Calibration	W81-70433
677 47-02	
MICROWAVE TRANSMISSION	
Advanced Energetics	W81-70226
506-55-12	
High Efficiency Technology for Microwave Amplifiers	W81-70250
506 61-22	
MICROWAVES	
Electrophysics	W81 70208
506-54-42	
Remote Sensing of Air Sea Interactions Phenomena	W81 70335
146-40-05	

MULTISPECTRAL BAND SCANNERS

MICROWAVE Remote Sensing for Ice Processes Research	ATD General
146-40-06	W81 70336
Advanced Ocean Sensor Systems Development	W81 70339
146 40-13	
Advanced Ocean Sensor Systems Development	W81 70340
146-40-13	
Extended Scene Radar Calibration	W81 70433
677-47-02	
Antenna Systems Development	W81-70584
310 20 65	
MIDAIR COLLISIONS	
Aviation Operations Safety Technology	Wind Shear and Collision Avoidance
505-44 28	W81-70112
MIE SCATTERING	
Theoretical Studies of Radar Backscatter	W81-70422
677-41 11	
MILITARY AVIATION	
Advanced Rotor Systems Technology/RSRA Operations	W81-70136
532-03 11	
Tilt Rotor Research Aircraft Flight Investigations	W81-70137
532-04 11	
MILITARY SPACECRAFT	
Earth Orbital Platform Systems	Auxiliary Electric Propulsion for Spacecraft Systems
506-62 62	W81-70266
MILLIMETER WAVES	
Radio Astronomy	W81 70507
188 41 55	
MINERAL DEPOSITS	
High Spectral Resolution Remote Sensing	W81 70420
677 41 08	
MINERAL EXPLORATION	
Phase B Studies	Landsat Solid-State Sensor (LSS)
677 29 09	W81 70417
NASA/Geosat Test Case Study	W81 70418
677 41 02	
MINERALOGY	
Planetary Materials	Lunar Sample Analysis
152 01-40	W81 70442
Planetary Materials	Laboratory and Analytical Studies
152 02-40	W81 70443
Experimental Studies	W81 70447
152 02 40	
MINERALS	
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies	W81 70430
677 45-03	
MINES (EXCAVATIONS)	
Surface Mine Rehabilitation Inventory and Monitoring	W81 70411
677 21 20	
MINIATURE ELECTRONIC EQUIPMENT	
Flight Research Instrumentation Development	W81 70012
505 31-54	
MINICOMPUTERS	
Aeronautical Structural Design Methods	W81 70044
505 33-63	
MISSILE DESIGN	
Combat Vehicle and Missile Aerodynamics and Flight Dynamics	W81 70095
505 43 23	
MISSILE SYSTEMS	
Interagency and Industrial Assistance and Testing	W81 70096
505-43-31	
Interagency and Industrial Assistance and Testing	W81 70097
505-43 33	
MISSION PLANNING	
Advanced Space Structures	W81-70199
506-53-43	
Far Outer Planets Spacecraft Technology Definition	W81 70282
540-02 15	
Technology Requirements of Future Integrated Space Transportation Systems	W81 70284
540-03 13	
Shuttle Derived Vehicle Technology Requirements	W81 70285
540 03 19	
Space Systems and Planning Analysis	W81 70286
540-04 10	
Environmental Monitoring Research Satellite Mission Studies	W81-70349
146 60 02	
JSC General Operations Support	Planetary Materials
152-05 40	W81 70445
Mars Data Analysis Program Geology	W81 70483
155 50 01	
Instrument Development for Spacelight Experiments	W81 70488
157 03 40	
Particle and Particle Field Interactions	W81 70488
170 36 55	W81 70490
Development of Experiments and Hardware for Solar Physics Research	W81 70495
170 38 51	
Development of Solar Spacelab Experiment and Hardware	W81 70496
170 38 51	
Advanced Mission Studies	W81-70517
188 78 60	
Interdisciplinary Research	W81 70547
199 90 71	
Spacelab Science Payloads Definition	ATD General
358 78 01	W81 70550
Development of Shuttle Infrared Telescope Facility (SIRTF)	W81 70551
358 41-06	
MOTION SICKNESS	
Operational Laboratory Support	W81 70534
199 10 10	
Space Motion Sickness	W81-70538
199-20 00	
MOTION SIMULATORS	
Simulation Technology for Aeronautics	W81 70059
505 35 31	
MULTIPLE ACCESS	
Technical Consultation Services	W81-70375
643-10-01	
Remote Sensing Frequency Coordination Studies	W81-70380
643 10 04	
MULTISPECTRAL BAND SCANNERS	
Sensor Systems Technology	W81-70254
506 61 33	
Remote Sensing of Subsurface Drain Malfunctions	W81-70317
141 20 21	
Integration of VIS-IR-NW Data	W81-70410
677 21 06	
Surface Mine Rehabilitation Inventory and Monitoring	W81 70411
677-21 20	

Tectonic Structure in Pakistan	W81 70426	NEUTRONS	X-Ray Gamma Ray and Neutron Gamma Ray Methods for Planetary Exploration	505 43 22	Combat Veh & Missile Aerodyn & Flight Dyn R & T
677-43-03			157 03 50	535 02 12	Variable Cycle Engine Technology
Aircraft Thermal Infrared Scanner				506-52-19	W81 70168
677-47-01	W81 70432	NEWTON THEORY	Development of a Shuttle Flight Experiment Drop Dynamics Module	Advanced Reusable Main Engine Technology	W81 70182
Very Low-Cost Data System	16-Bit		542 03 01	Solar Rankine Cycle Applications Study	W81 70303
Microprocessor Driven ELAS				776-91 59	
677-76-04	W81 70437	NICKEL	Electrochemical Energy Conversion and Storage	505-32 12	Nozzle Design
Multispectral Linear Arrays			506 55 52	Inlet Nozzle and Propeller Research	W81 70020
Sensor Systems			W81 70236		
506-61-36	W81 70256	NICKEL CADMIUM BATTERIES	Advanced Nickel Cadmium and Lithium Batteries		
Phase B Studies - Landsat Solid State Sensor (LS3)			506 55 55		
677-29-09	W81 70417	NIMBUS PROJECT	O-STA/ADS Data Systems Standards and Guidelines	188-46 57	NUCLEAR FUSION
Multispectral Linear Arrays for the Short-Wave Infrared (MLA/SWIR)			Program	Gamma-Ray Astronomy	W81-70511
677-77-01	W81 70438		656 13 10	Pipeline/Nuclear Plant Engineering Geology	
MULTISPECTRAL PHOTOGRAPHY			Oceanic Data Utilization System Study	677 44 01	NUCLEAR POWER PLANTS
Mult-Spectral Detectors and Sensors			656-13-60	Theoretical Studies of the Upper Tropospheric Aerosol Layer and Sahara Dust	W81 70428
506 54-46	W81 70211	NIMBUS SATELLITES	Upper Atmosphere Research - Theoretical Studies	146 20-23	NUCLEATION
Geological Mapping Kilauea Caldera Stratigraphy			147 30 01	188-46 56	NUCLEI (NUCLEAR PHYSICS)
677 41-09	W81 70421		W81 70360	Particle Astrophysics	Particle Astrophysics
Pipeline/Nuclear Plant Engineering Geology				188-46 56	W81 70508
677 44-01	W81 70428	NITROGEN OXIDES	Advanced Low Emission Combustor (ALEC)	188-46 56	Particle Astrophysics and Shuttle Experiment Definition
Planetary Synthesis			511-55 12	W81 70121	W81 70509
153 06-70	W81 70451		Stratospheric Theoretical Studies and Science Definition Activities		
Earth Based Solar System Observations			147 30 01	505 31-83	NUMERICAL ANALYSIS
196 41-78	W81-70528		W81 70361	Computational Fluid Mechanics for Turbomachinery	Applied Mathematics
			Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere	505-32 52	W81 70015
			147-30 01	Commercial Fisheries Ocean Forecast Demonstration	W81 70025
N		NOISE MEASUREMENT	Noise Reduction Technology for Short Haul Aircraft	663-90 03	NUCLEAR WEATHER FORECASTING
NASCOM NETWORK			505 32 01		Numerical Climate Modeling
Satellite Communications Technology			Propulsion Noise Research	146-10 02	W81 70323
310-20-38	W81-70581		505-32 02	Global Weather Research	
NATURAL LANGUAGE (COMPUTERS)			Variable Cycle Engine Technology	146 30 02	W81 70330
Human To Machine Interface Technology			535-02 12		
310 40-37	W81 70591		Advanced Turboprop Flight Research		
NATURAL SATELLITES			535-03 14	146-10 02	O
Planetary Synthesis			W81 70171	Oblique Wings	
153 06-70	W81 70451	NOISE POLLUTION	Human Response to Noise	505-43 44	Remotely Piloted Research Aircraft Technology
Planetary Atmospheric Dynamics			505-35 13	196 41 52	W81-70099
154-20-80	W81 70459		W81 70055	OBSERVATORIES	
Ground Based Optical Planetary Astronomy			505-36 13	Imaging Studies of Comets	
196-41-80	W81 70529	NOISE PREDICTION (AIRCRAFT)	Noise Reduction Technology for Short Haul Aircraft	196 41 52	
Ground Based Radio and Radar Planetary Astronomy			505 32 01	W81 70522	
196-41 85	W81-70532		Propulsion Noise Research	OCCULTATION	
Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn			505-32 02	Laser Heterodyne Spectrometer (LHS) Brassboard	
385-36 04	W81 70558		Propulsion Noise Research	147 40-01	W81 70366
NAVIER-STOKES EQUATION			505-32 03	OCEAN BOTTOM	
Computational Fluid Dynamics			Basic Noise Research	Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment HEBBLE)	
505-31 13	W81-70002		505-32 05	637-01 04	W81 70383
NAVIGATION			Human Response to Noise	OCEAN CURRENTS	
VLBI Development and Analysis			505 35 13	Ocean Circulation and Topography	
310-10 61	W81-70576		W81 70055	146-40 07	W81-70337
Frequency and Timing Research			505-41 43	Scatterometer Data Analysis	
310-10 62	W81 70577		W81 70075	146-40 12	W81-70338
Navigation Technology Development			505-42 02	OCEAN DATA ACQUISITIONS SYSTEMS	
310-10 63	W81-70578		Propulsion Structures Vibration Aeroelasticity and Acoustics	Seasat Data Utilization Project	
NAVIGATION AIDS			505-42 13	146-01 00	W81-70322
Navigation and Guidance Short-Range Operations			Advanced Rotorcraft Systems Technology Materials and Noise	OSTA Data Systems Standards and Guidelines	
505-34 11	W81-70047		532 06 13	556-13 10	W81-70390
Flight Management Systems			W81 70142	ADS Oceanic Pilot System Project	
505-35 21	W81-70056	NOISE PROPAGATION	Propulsion Noise Research	556-13-40	W81-70394
General Aviation Avionics and Control Technology			505 32 03	Oceanic Data Utilization System Study	
505 41 63	W81-70077		W81 70018	656-13-60	W81-70395
Planetary & Solar Spacecraft Systems Automated Optical Navigation			505-32 05	Registration of Radar and Other Data	
506-62 55	W81-70265	NOISE REDUCTION	Basic Noise Research	656 45-02	W81 70399
NEAR FIELDS			505-32 05	OCEAN MODELS	
Advanced Turboprop- Interior Noise			W81 70019	Climate Research	
535-03 13	W81 70170		505-32 01	146-10 03	W81-70324
NEBULAE			Propulsion Noise Research	OCEAN SURFACE	
UV and Optical Astronomy			505 32 02	Microscale Ocean Surface Dynamics	
188-41 51	W81 70502		Propulsion Noise Research	146-40 05	W81-70333
Sounding Rockets Experiments (Astronomy)			505-32 03	Ocean Wave Height Determination with the Synthetic Aperture Radar	
879 11 41	W81 70571		Basic Noise Research	146 40 05	W81-70334
NEPTUNE ATMOSPHERE			505-32 05	Remote Sensing of Air Sea Interactions Phenomena	
Optical Astronomy			W81 70019	146-40 05	W81-70335
196 41 71	W81 70525		Loads Aeroelasticity and Structural Dynamics	Ocean Circulation and Topography	
NETHERLANDS			505 33 53	146 40 07	W81-70337
X Ray Timing Explorer (XTE)			General Aviation Propeller Noise Reduction	Scatterometer Data Analysis	
685 20 11	W81 70567		505-41 43	146 40-12	W81 70338
NEUROPHYSIOLOGY			Low Speed Propeller Research	Advanced Ocean Sensor Systems Development	
Space Motion Sickness			505-41 52	146 40 13	W81-70339
199 20 00	W81 70538		Helicopter Transmission Technology	146 40 05	
NEUTRAL ATOMS			511-58 12	Scatterometer Data Analysis	
Aeronomy Energy Deposition			W81 70122	146 40-12	W81 70338
154 70 80	W81 70470		Long Haul Transport Aircraft Systems Studies	Advanced Ocean Sensor Systems Development	
NEUTRAL GASES			530 04 13	146 40 13	W81-70339
Planetary Atmosphere Experiment Development			W81 70130		
154 90 80	W81-70477		SCR Propulsion Technology		
Sounding Rockets Magnetospheric Physics Experiments			533-01 32	OCEAN THERMAL ENERGY CONVERSION	
828 11 36	W81-70568		SRC - Aerodynamic Performance Technology	Ocean Thermal Energy Conversion	
NEUTRON ACTIVATION ANALYSIS			533-01 43	Assessment	
In-Situ Measurements of Stratospheric Ozone and Total Chlorine			Variable Cycle Engine Technology	146 40 05	
147 10 01	W81 70353		535-02 12	W81 70302	
NEUTRON IRRADIATION			Advanced Turboprop Interior Noise	776 91-40	OCEANOGRAPHIC PARAMETERS
In-Situ Instrumentation for Developing Nuclear Waste Isolation Sites			W81 70170	Sensor Systems Technology	
775 16 27	W81-70298		535-03 13	506 61 33	W81 70324
NEUTRON STARS			W81 70170	Ocean Thermal Energy Conversion	
X Ray Astronomy				776 91-40	Study and
188 46 59	W81 70513			Seasat Data Utilization Project	Assessment
				146 01-00	
				ADS Oceanic Pilot System Project	
				656 13-40	W81 70394

SUBJECT INDEX

SUBJECT INDEX			PERIODIC VARIATIONS	
Oceanic Data Utilization System Study	656 13-60	W81-70395	Environmental Monitoring Research Satellite Mission Studies	Advanced Carbon Carbon Stand Off Panel
Resistration of Radar and Other Data	656 45-02	W81-70399	146-60 02 Atmospheric Lidar System Definition	506-53-37 W81 70197
OCEANOGRAPHY	Advanced Ocean Sensor Systems Development	146-40-13	146 60 03 Upper Atmosphere Research Field Measurements	PARABOLIC REFLECTORS
Coastal and Estuarine Dynamic Processes Research	146 40 15	W81-70339	147 10 01	Study of Large Deployable Antennas for Astronomy
Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment -HEBBLE)	637 01-04	W81-70383	Applications	358 78-80 W81-70553
Commercial Fisheries Ocean Forecast Demonstration	663-90-03	W81-70401	OPTIMAL CONTROL	AV-BA V/StOL Flight Experiments
OCEANS	Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	637 01 03	Navigation and Guidance Short-Range Operations	505-42-74 W81 70089
OFFSHORE PLATFORMS	Ocean Thermal Energy Conversion Study and Assessment	776 91-40	Aircraft Controls Theory and Techniques	Flight Dynamics and Handling Qualities
OGO	Atmosphere Ionosphere Magnetosphere Interactions	385-38 01	505 34 33	505-43-14 W81 70092
ON-LINE PROGRAMMING	NASA End-to-End Data System (NEEDS) Data Base Management/Archival Mass Memory	506-61 59	OPTIMIZATION	Terrain Models for SAR Development
ONBOARD EQUIPMENT	Atmospheric Lidar System Definition	146 60-03	Integrated Analysis and Synthesis	677 43-01 W81 70425
Operations Support Computing Technology	Upper Atmosphere Research Field Measurements	147 10-01	Optimization of Structural Systems	PARAMETRIC FREQUENCY CONVERTERS
OPERATOR PERFORMANCE	Advanced Technological Development General Signal and Data Processing Electronics Solid State Detectors	188-78 51	Loads Dynamics and Aeroelasticity	Radio Systems Development
OPERATIONS RESEARCH	Atmospheric Lidar System Definition	W81-70350	ORBITAL ASSEMBLY	310-20-66 W81 70585
OPTICAL COMMUNICATION	Planetary Clouds Particulates and Ices Clouds of Venus	154-20 80	Space Engineering	PARTICLE ACCELERATORS
OPTICAL DATA PROCESSING	Atomic and Molecular Properties	154-30 80	506-53 10 Intelligent Systems Research	Particle Accelerator Facility Maintenance and Operation of a Calibration Facility for Magnetospheric and Solar-Terrestrial Experiments
OPTICAL EQUIPMENT	Mission Operations Technology	154 50-80	506 54 83 Large Space Structure System Engineering	170 36-57 W81 70494
OPTICAL MEASURING INSTRUMENTS	Fiber-Optically Mosaiced Large Area Image Sensors	188 41 54	906 55 00	PARTICLE FLUX DENSITY
OPTICAL RADAR	Image Processing Technology	310 40 46	ORBITAL MECHANICS	Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn
OPTICAL RADAR	Fiber-Optically Mosaiced Large Area Image Sensors	188 41 54	310 10 26 Attitude/Orbit Systems Technology	385 36-04 W81 70558
OPTICAL RADAR	Quantum Electronics Devices and Sensors	505 34-34	ORBITAL POSITION ESTIMATION	PARTICLE INTERACTIONS
OPTICAL RADAR	Quantum Electronics Devices and Sensors	506-54-43	Navigation Technology Development	Particles and Particle/Field Interactions
OPTICAL RADAR	Quantum Electronics Devices and Sensors	506-54-43	310 10 63	170-36 55 W81 70492
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	ORBITAL WORKERS	PARTICLE SIZE DISTRIBUTION
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Space Engineering	Planetary Clouds Particulates and Ices Clouds of Venus
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506 53 10	154-30 80 W81-70462
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	ORGANIC COMPOUNDS	PASSENGER AIRCRAFT
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Fundamentals of Mechanical Behavior of Composites	Long Haul Transport Aircraft Systems Studies
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Matrices	530 04-13 W81 70130
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OSCILLATORS	PATTERN RECOGNITION
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Multi Spectral Detectors and Sensors	Intelligent Systems Research
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506 54 46	506 54-83 W81 70222
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Remote Sensing Systems	Robotics/Machine Intelligence Automated Systems
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506 61 35	506-54-85 W81 70223
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OSO-8	High Spectral Resolution Remote Sensing
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	X Ray Astronomy Data Analysis	677-41 08 W81 70420
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	389 46 04	Terrain Models for SAR Development
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OSO-8	677-43-01 W81-70425
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	X Ray Astronomy Data Analysis	677 43-03 W81-70426
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OUTGASSING	PATTERN REGISTRATION
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Interior Models	Image Processing Technology
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	153 03 42	310 40-46 W81 70593
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OUTLETS	PAYOUTLOAD RETRIEVAL (STS)
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Intake Nozzle and Propeller Research	Satellite Services
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	505 32 12	906 75-00 W81 70599
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OXIDATION	PAYOUTLOADS
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Metallic/Ceramic Materials	Loads Dynamics and Aeroelasticity
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	505 33 12	506-53 63 W81 70202
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OXIDATION	Payload Environments and Dynamics
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	505 33 12	506-53 66 W81-70205
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OXIGEN	Space Vehicle Dynamics
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506 53 17	506-53 69 W81-70206
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	OZONE	Far Outer Planets Spacecraft Technology Definition
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	In Situ Measurements of Stratospheric Ozone and Total Chlorine	540-02-15 W81-70282
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Stratospheric Research Field Measurements Program	Long Duration Exposure Facility
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Chemical Kinetics	542 04-13 W81 70296
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	147 20 01	Development of Solar Spacelab Experiment and Hardware
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Upper Atmosphere Research - Theoretical Studies	170 38-51 W81 70496
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	147 30 01	Spacelab Science Payloads Definition ATD General
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere	356-78 01 W81-70550
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	147 30 01	Development of Shuttle Infrared Telescope Facility (SIRTF)
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Aeronomy of Planetary Atmospheres Chemistry	358-41 06 W81-70551
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	154 75-80	Spacelab Science Payload Definitions ATD General
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Global Terrestrial Ecology	358 78 01 W81-70552
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	199 70 31	PELLETS
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70546	Fusion Target Technology Study
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	146 60-01	179 20-57 W81-70369
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70346	PERCEPTION
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Improved Measurement and Calibration Techniques for Stratospheric Trace Species	Man Machine Systems
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	146 60 01	Advanced Teleoperation Studies
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70348	199-60 80 W81-70545
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	PERFORMANCE PREDICTION	PERFORMANCE PREDICTION
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Ozone Data Reduction and Analysis and Solar UV Variability	Advanced V/StOL Aircraft Aerodynamics and Flight Dynamics Research
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	146 60-01	505-42 71 W81-70088
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70346	Computational and Experimental Aerothermodynamics
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506-51 11	506-51 11 W81-70173
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Loads Dynamics and Aeroelasticity	506-53 63 W81-70202
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506-53 64	506-53 64 W81-70203
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	MPD Thruster System Technology	506-55 35 W81-70232
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	506-55 45	Planetary Solar Array Research and Technology W81 70235
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Advanced Teleoperation Studies	199-60 80 W81-70545
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70348	PERFORMANCE TESTS
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Fire Systems Full-Scale Test	534 05 17 W81-70166
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Fund for Independent Research	506-56 16 W81-70247
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	W81 70348	PERIODIC VARIATIONS
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	Upper Atmosphere Research Field Measurements	Upper Atmosphere Research Field Measurements W81-70352
OPTICAL RADAR	Quantum Electronics Devices and Sensors	147 10 01	147 10-01	147 10-01

P

P N JUNCTIONS	Solar Cell Research	W81 70234
PACIFIC OCEAN	Commercial Fisheries Ocean Forecast Demonstration	W81-70401
PAKISTAN	Tectonic Structure in Pakistan	W81 70426
PANEL METHOD (FLUID DYNAMICS)	Aerodynamic Theory/Experimental Integration	W81 70007
PANELS	High Temperature Aeronautical Structures	W81-70046

PERSONNEL SELECTION

Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection)
199 10 20 W81 70535

PETROLOGY

Geological Mapping Kilauea Caldera Stratigraphy

677 41 09 W81 70421

Petrologic and Geophysical Studies of the Source of Long

Wavelength Crustal Magnetic Anomalies

677 45 03 W81 70430

Planetary Materials Lunar Sample Analysis

152 01 40 W81-70442

Experimental Studies

153 02 40 W81 70447

Petrology Lab

153 02 70 W81 70448

Interior Models

153 03 42 W81 70449

Mars Data Analysis Program

155 20 40 W81 70480

PHASE SHIFT

Remotely Sensed Electromagnetic Characteristics of

Snow and Soil Moisture

677 22 12 W81 70413

PHASE TRANSFORMATIONS

Glass Research

179 80-30 W81 70373

PHASED ARRAYS

Earth Satellite Communication Antenna Development

541 02 15 W81-70288

PHOTOABSORPTION

Ultraviolet Spectroscopy of Planetary Atoms and

Molecules

154 70-80 W81 70469

PHOTOCHEMICAL OXIDANTS

Photochemical Modeling of Trace Species in the

Stratosphere and Mesosphere

147 30-01 W81-70362

Aeronomy of Planetary Atmospheres Chemistry

154 75-80 W81 70472

PHOTOCHEMICAL REACTIONS

Advanced Radiant Energy Conversion

506 55-13 W81 70227

In-Situ Measurements of Stratospheric Ozone and Total

Chlorine

147 10-01 W81 70353

Chemical Kinetics

147 20-01 W81 70358

Upper Atmosphere Research Theoretical Studies

147 30-01 W81 70360

Stratospheric Theoretical Studies and Science Definition

Activities

147-30-01 W81 70361

Upper Atmosphere Research Satellites (UARS) Definition

Study

147-40-01 W81-70365

Aeronomy Theory and Analysis

154 60-80 W81 70468

Cosmic Chemistry Aeronomy Comets Grains

154-75-80 W81-70471

Aeronomy Chemistry

154-75-80 W81-70473

PHOTOELECTRIC EMISSION

Aeronomy Energy Deposition

154-70-80 W81-70470

PHOTOGEOLOGY

Planetary Aeolian Processes on Planets

151-01-60 W81-70439

Planetary Geology

151-01 70 W81-70440

Radar Studies

153-07 70 W81-70453

PHOTOLYSIS

Aeronomy of Planetary Atmospheres Chemistry

154-75 80 W81-70472

PHOTOMETERS

Sensor Systems Technology

506-61 33 W81-70254

Earth Based Solar System Observations

196 41 78 W81-70528

Astronomical Optical Instrument Development

196-41 81 W81-70530

PHOTONS

Gamma Ray Astronomy

188 46 57 W81-70510

PHOTOSPHERE

Data Analysis Solar Physics

385 38 01 W81-70560

PHOTOVOLTAIC CELLS

Planetary Solar Array Research and Technology

506 55 45 W81 70235

Power Systems Management and Distribution

506-55-72 W81 70240

PHYSICAL CHEMISTRY

Experimental Studies

153-02 40 W81 70447

Planetary Atmospheric Composition and Structure

154 10 80 W81 70457

MDAP Geology

155 50-01 W81-70485

PHYSICAL EXERCISE

Crew Health Maintenance

199 10-30 W81-70536

PHYSICAL FITNESS

Crew Health Maintenance

199-10 30 W81 70536

PHYSICAL PROPERTIES

Surface Physics and Computational Chemistry

506-53-11 W81 70188

PHYSICS

Funds for Independent Research (Space)

506 56-11 W81 70244

Fund for Independent Research (Space)

506 56-12 W81 70245

PHYSIOLOGICAL EFFECTS

Fluid and Electrolyte Change

199 20-60 W81 70540

PHYSIOLOGICAL RESPONSES

Interdisciplinary Research

199 90 71 W81 70547

PICOSECOND PULSES

Data Transmission and Processing Research

506 54-55 W81 70212

PILOT PERFORMANCE

General Aviation Aircraft Aerodynamics and Flight

Dynamics

505 41-18 W81 70072

General Aviation Single Pilot IFR Systems

505 41-73 W81 70079

PILOTS (PERSONNEL)

Crew Interaction with Advanced Flight Systems

505 35-23 W81 70057

PIONEER SPACE PROBES

Pioneer 6 11 Plasma Data Analysis

385 36-01 W81 70556

PIONEER VENUS SPACECRAFT

Planetary Atmospheric Composition and Structure

154 10 80 W81-70457

Planetary Clouds Particulates and Ices Clouds of

Venus

154 30 80 W81 70462

Clouds Particulates and Ices

154 30 80 W81-70463

PIONEER 10 SPACE PROBE

Planetary Atmospheres Composition and Structure

154 10 80 W81 70458

Energetic Particles and Plasmas in the Magnetospheres

of Jupiter and Saturn

385 36 04 W81 70558

PIONEER 11 SPACE PROBE

Planetary Atmospheres Composition and Structure

154 10 80 W81 70458

Energetic Particles and Plasmas in the Magnetospheres

of Jupiter and Saturn

385 36 04 W81 70558

PIPES (TUBES)

Commercialization an Orbital Tube Flaring System

141 95 01 W81 70319

PISTON ENGINES

Stirling Engine Components and System Concepts

778 46 22 W81 70307

Validation of Stirling Lab Engine

778 46-35 W81 70308

PISTONS

Stirling Engine Components and System Concepts

778 46 22 W81 70307

Validation of Stirling Lab Engine

778 46 35 W81 70308

PISTONS

Stirling Engine Components and System Concepts

778 46 22 W81 70307

Validation of Stirling Lab Engine

778 46 35 W81 70308

PLANETARY ATMOSPHERES

Interior Models

153 03-42 W81 70449

Planetary Atmospheric Composition and Structure

154 10 80 W81 70457

Planetary Atmospheres Composition and Structure

154 10 80 W81 70458

Planetary Atmospheric Dynamics

154 20 80 W81 70459

Dynamic Radiative Interaction

154 20-80 W81 70461

Clouds Particulates and Ices

154 30 80 W81 70463

Radiative Transfer in Cloudy Atmosphere

154-40 80 W81-70464

Atomic & Molecular Properties of Planetary Atmospheric Constituents

154-50 80 W81 70465

Atomic and Molecular Properties

154 50 80 W81-70466

Planetary Aeronomy Theory and Analysis

154 60 80 W81 70467

Ultraviolet Spectroscopy of Planetary Atoms and Molecules

154 70-80 W81 70469

Cosmic Chemistry Aeronomy Comets Grains

154 75 80 W81 70471

Aeronomy Chemistry

154 75-80 W81 70473

Extended Atmospheres

154 80 80 W81 70474

Atmospheric Experiment Development

154 90-80 W81 70476

Planetary Atmosphere Experiment Development

154 90-80 W81 70477

Ground Based Infrared Astronomy

196 41-50 W81 70520

Advanced Infrared Astronomy and Laboratory

Astrophysics

196 41 54 W81 70523

INFRARED ASTRONOMY

196 41 72 W81 70526

LABORATORY SUPPORTING STUDIES (ASTRONOMY)

196 41 84 W81 70531

THEORETICAL PLANETARY ASTRONOMY

196 41 85 W81 70533

INFRARED COMPOSITION

Integrated Study of Continental Rift Systems

677 43 05 W81-70427

EXPERIMENTAL STUDIES

153 02 40 W81 70447

PETROLOGY LAB

153 02 70 W81-70448

INTERIOR MODELS

153 03 42 W81 70449

LABORATORY SUPPORTING STUDIES (ASTRONOMY)

196 41 84 W81 70531

INFRARED ASTRONOMY

196 41 85 W81 70533

INTEGRATED STUDY OF CONTINENTAL RIFT SYSTEMS

677 43 05 W81-70427

THEORETICAL STUDIES OF PLANETARY BODIES

151 02 60 W81 70441

PLANETARY MATERIALS

Lunar Sample Analysis

152 01 40 W81 70442

PLANETARY MATERIALS

Laboratory and Analytical Studies

152-02 40 W81 70443

FORMATION, EVOLUTION, AND STABILITY OF PROTO-STAR DISKS

153 01 60 W81 70446

PLANETARY DYNAMICS

Planetary Dynamics

153 05 70 W81 70450

NASA AMES RESEARCH CENTER VERTICAL GUN FACILITY

153 08 60 W81 70455

PLANETARY MAGNETIC FIELDS

Radio and Radar Planetary Studies

196-41 51 W81 70521

RADAR STUDIES

Radar Studies

153 07 70 W81 70453

PLANETARY ORBITS

Advanced Nickel Cadmium and Lithium Batteries

506 55 55 W81 70237

PLANETARY ROTATION

Dynamics of Planetary Atmospheres

154 20 80 W81 70460

PLANETARY SURFACES

Advanced Chemical Propulsion Concepts For Planetary

Spacecraft

506-52 35 W81 70185

THEORETICAL STUDIES OF RADAR BACKSCATTER

677 41-11 W81 70422

PLANETARY TEMPERATURE

Dynamics of Planetary Atmospheres

154 20 80 W81 70460

PLANETOLOGY

Petrology Lab

153 02 70 W81-70448

PLANETARY SYNTHESIS

153 06 70 W81 704

SUBJECT INDEX

PLASMA SHEATHS	Advanced Radiant Energy Conversion	W81 70227	PROTECTIVE COATINGS
Magnetospheric Data Analysis	506-55 13		Advanced Manned Vehicle Onboard Propulsion
385 36-01	Advanced Energy Technology	W81 70228	Technology
PLASMA WAVES	506 55 15	506 52 17	506 52 17
Particles and Particle/Field Interactions	Advanced Power System Technology	W81 70242	Advanced Chemical Propulsion Concepts For Planetary
170-36 55	506 55 76	Spacecraft	506 52 35
Atmosphere Ionosphere Magnetosphere Interactions	Multi KW Low Cost Earth Orbital Systems	W81 70243	W81 70185
385-36-01	506-55-79		
Data Analysis	Solar Rankine Cycle Applications Study	W81 70303	
Space Plasma Physics	776 91 59		
385 36 02	778 50-29	W81-70315	
PLASMA-PARTICLE INTERACTIONS	Advanced Energy Technology for Utilities		
Sounding Rockets	778 50-29		
Magnetospheric Physics Experiments	W81 70568		
828-11-36			
PLASMAS (PHYSICS)			
Power Systems Management and Distribution	Quiet Propulsive Lift Technology Experiments	Aircraft	
506-55 72	Performance and Operating Systems Research	532-02-11	
Planetary Astronomy Theory and Analysis	QPLT Systems Technology	W81 70134	
154-60-80	532-02-12	W81 70135	
Sounding Rockets	V/STOL Systems Technology	532-05 11	
Magnetospheric Physics Experiments	W81 70568	W81 70139	
828 11 36			
PLASMAPHERE			
Magnetospheric Data Analysis	Aviation Meteorology Research Severe Storms	505 44 13	
385-36 01	W81 70555	W81 70102	
PLASTICS	PREDICTION ANALYSIS TECHNIQUES		
Fundamentals of Mechanical Behavior of Composites	General Aviation Aerodynamic Performance Technology	505-41 11	
Matrices	Rotocraft Aeroelasticity and Structural Dynamics	505 42 11	
506-53 15	Turbine Engine Hot Section Technology (HOST)	506 56 16	
PLUMES	510-57 12	W81-70120	
Plume Characterization	Advanced Turboprop -Interior Noise	535-03 13	
506-52-39	W81-70186	W81 70170	
PLUTO (PLANET)	Fund for Independent Research	505 32 13	
Planetary Dynamics	Fuel Tank Sealants	W81 70247	
153 05 70	533 01 11	W81 70143	
POLAR CAPS	PRESSURE GRADIENTS		
MDAP Geology	Hypersonic Propulsion Research	505 32 93	
155-50-01	Space Shuttle Aerodynamic Experiments	W81 70030	
POLAR WANDERING (GEOLOGY)	506-51-34	W81 70179	
Global Earth Dynamics and Structure	PRESSURE SENSORS		
676 30 01	Flight Research Instrumentation Development	505 31 54	
POLARIMETRY	Automated Decision Making and Problem Solving	506 54-73	
X Ray Astronomy - Time Variability and Polarimetry	PROCESS CONTROL (INDUSTRY)		
188-46 59	Industrial Conservation Cogeneration and Utilization of Alternative Fuels	506-61 37	
POLARIZATION (WAVES)	778 49 15	W81 70313	
Analysis of Multifrequency/Multipolarization SAR Imagery	PRODUCT DEVELOPMENT		
677 41 12	Materials for Advanced Turbine Engines (MATE)	510-53 12	
POLARIZATION CHARACTERISTICS	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)	W81 70117	
Advanced Synthetic Aperture Radar Technology	776 91 19	W81 70300	
506-61 37	Atmospheric Lidar System Definition	146-60 03	
POLLUTION MONITORING	PRODUCTIVITY		
Global Tropospheric Models Monitoring	Space Engineering	506 53 10	
146 20-08	506-53 10	W81 70187	
Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring	PROJECT MANAGEMENT		
146 20 10	Funds for Independent Research (Space)	506 56 11	
Theoretical Studies of the Upper Tropospheric Aerosol Layer and Sahara Dust	Fund for Independent Research (Space)	W81 70244	
146 20-23	506 56 12	W81 70245	
POLYBUTADIENE	Fund for Independent Research (Space)	506 56-13	
Aircraft Systems Operational Safety and Efficiency Improvement	Satellite Communications Technology	541 02 12	
505-44 31	Long Duration Exposure Facility	542 04-13	
POLYIMIDE RESINS	Energy Planning Support at JPL	778-45 35	
Composites for Propulsion Components	NASA Ames Research Center Vertical Gun Facility	153 08 60	
505 33-32	153 10 40	W81-70455	
POLYMER MATRIX COMPOSITE MATERIALS	Interdisciplinary Space Science Research	188-48 51	
Fire Resistant Materials	JSC General Operations - Geophysics and Geochemistry	W81 70514	
505-33 31	153 10 40	W81-70456	
POLYMERIC FILMS	153 10 40	W81-70456	
Fire Resistant Materials	Interdisciplinary Space Science Research	188-48 51	
505 33-31	JSC General Operations - Geophysics and Geochemistry	W81 70514	
POLYMERIZATION	PROJECT PLANNING		
Aircraft Systems Operational Safety and Efficiency Improvement	Ocean Thermal Energy Conversion Study and Assessment	776 91 40	
505-44 31	Cosmic Background Explorer (COBE)	W81 70302	
POLYMERS	685-20 08	W81 70586	
Composites	PROPAGATION MODES		
505 33 33	Laser/VLBI Propagation Medium Analysis	676 59 35	
Fundamentals of Mechanical Behavior of Composites	Laser/VLBI Propagation Medium Analysis	676-59 37	
Matrices	W81 70037	W81 70407	
506 53 15	W81 70190	W81 70408	
Effects of Space Environment on Composites	W81 70193	W81 70408	
PORTABLE EQUIPMENT	PROPELLANT TESTS		
Communication Satellite Application Systems	Laser Propulsion	506 55 19	
643 10 02	W81 70377	W81-70229	
POSITIVE IONS	W81 70470		
Aeronomy Energy Deposition			
154 70 80			
POSTFLIGHT ANALYSIS			
Operational Laboratory Support			
199-10 10			
Crew Health Maintenance			
199 10 30			
POWER METALLURGY			
Metallic/Ceramic Materials			
505 33-12			
Advanced Aluminum Alloys			
505-33-13			
POWER CONDITIONING			
Advanced Energetics			
506 55-12			

PROTECTIVE COATINGS

PROPELLANTS	Advanced Radiant Energy Conversion	W81 70227	PROPELLERS
Magnetospheric Data Analysis	Advanced Energy Technology	W81 70228	Airfoil Development
385 36-01	Advanced Power System Technology	W81 70242	505 31 33
Particles and Particle/Field Interactions	Multi KW Low Cost Earth Orbital Systems	W81 70243	Inlet Nozzle and Propeller Research
170-36 55	506-55-79	W81 70243	505-32 12
Atmosphere Ionosphere Magnetosphere Interactions	Solar Rankine Cycle Applications Study	W81 70303	Advanced Turboprop Flight Research
385-36-01	776 91 59	W81-70315	535 03 14
Data Analysis	Advanced Energy Technology for Utilities		General Aviation Propeller Noise Reduction
Space Plasma Physics	778 50-29		505-41-43
385 36 02	W81 70568		Low Speed Propeller Research
PLASMA-PARTICLE INTERACTIONS			505-41 52
Sounding Rockets	Advanced Energy Technology for Utilities		Propulsion Systems for Small Transports
Magnetospheric Physics Experiments	778 50-29		530 04 12
828-11-36	W81 70568		Advanced Turboprop Program
PLASMAS (PHYSICS)			535-03-12
Power Systems Management and Distribution	Quiet Propulsive Lift Technology Experiments		Advanced Turboprop Interior Noise
506-55 72	Performance and Operating Systems Research		535 03 13
Planetary Astronomy Theory and Analysis	QPLT Systems Technology		Propulsion
154-60-80	532-02-12		Airborne Experiment Platforms
Sounding Rockets	V/STOL Systems Technology		530 02-18
Magnetospheric Physics Experiments	532-05 11		W81 70128
828 11 36	W81 70568		
PLASMAPHERE			
Magnetospheric Data Analysis	Aviation Meteorology Research Severe Storms	505 44 13	
385-36 01	W81 70555	W81 70102	
PLASTICS	PREDICTION ANALYSIS TECHNIQUES		
Fundamentals of Mechanical Behavior of Composites	General Aviation Aerodynamic Performance Technology	505-41 11	
Matrices	Rotocraft Aeroelasticity and Structural Dynamics	505 42 11	
506-53 15	Turbine Engine Hot Section Technology (HOST)	506 56 16	
PLUMES	510-57 12	W81-70120	
Plume Characterization	Advanced Turboprop -Interior Noise	535-03 13	
506-52-39	W81-70186	W81 70170	
PLUTO (PLANET)	Fund for Independent Research	505 32 13	
Planetary Dynamics	Fuel Tank Sealants	W81 70247	
153 05 70	533 01 11	W81 70143	
POLAR CAPS	PRESSURE GRADIENTS		
MDAP Geology	Hypersonic Propulsion Research	505 32 93	
155-50-01	Space Shuttle Aerodynamic Experiments	W81 70030	
POLAR WANDERING (GEOLOGY)	506-51-34	W81 70179	
Global Earth Dynamics and Structure	PRESSURE SENSORS		
676 30 01	Flight Research Instrumentation Development	505 31 54	
POLARIMETRY	Automated Decision Making and Problem Solving	506 54-73	
X Ray Astronomy - Time Variability and Polarimetry	PROCESS CONTROL (INDUSTRY)		
188-46 59	Industrial Conservation Cogeneration and Utilization of Alternative Fuels	506-61 37	
POLARIZATION (WAVES)	778 49 15	W81 70313	
Analysis of Multifrequency/Multipolarization SAR Imagery	PRODUCT DEVELOPMENT		
677 41 12	Materials for Advanced Turbine Engines (MATE)	510-53 12	
POLARIZATION CHARACTERISTICS	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)	W81 70117	
Advanced Synthetic Aperture Radar Technology	776 91 19	W81 70300	
506-61 37	Atmospheric Lidar System Definition	146-60 03	
POLLUTION MONITORING	PRODUCTIVITY		
Global Tropospheric Models Monitoring	Space Engineering	506 53 10	
146 20-08	506-53 10	W81 70187	
Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring	PROJECT MANAGEMENT		
146 20 10	Funds for Independent Research (Space)	506 56 11	
Theoretical Studies of the Upper Tropospheric Aerosol Layer and Sahara Dust	Fund for Independent Research (Space)	W81 70244	
146 20-23	506 56 12	W81 70245	
POLYBUTADIENE	Fund for Independent Research (Space)	506 56-13	
Aircraft Systems Operational Safety and Efficiency Improvement	Satellite Communications Technology	541 02 12	
505-44 31	Long Duration Exposure Facility	542 04-13	
POLYIMIDE RESINS	Energy Planning Support at JPL	778-45 35	
Composites for Propulsion Components	NASA Ames Research Center Vertical Gun Facility	153 08 60	
505 33-32	153 10 40	W81-70455	
POLYMER MATRIX COMPOSITE MATERIALS	Interdisciplinary Space Science Research	188-48 51	
Fire Resistant Materials	JSC General Operations - Geophysics and Geochemistry	W81 70514	
505-33 31	153 10 40	W81-70456	
POLYMERIC FILMS	PROJECT PLANNING		
Fire Resistant Materials	Ocean Thermal Energy Conversion Study and Assessment	776 91 40	
505 33-31	Cosmic Background Explorer (COBE)	W81 70302	
POLYMERIZATION	685-20 08	W81 70586	
Aircraft Systems Operational Safety and Efficiency Improvement	PROPAGATION MODES		
505-44 31	Laser/VLBI Propagation Medium Analysis	676 59 35	
POLYMERS	Laser/VLBI Propagation Medium Analysis	676-59 37	
Composites	W81 70037	W81 70407	
505 33 33	W81 70190	W81 70408	
Fundamentals of Mechanical Behavior of Composites	W81 70193	W81 70408	
Matrices			
506 53 15			
Effects of Space Environment on Composites			
505-53 25			
PORTABLE EQUIPMENT			
Communication Satellite Application Systems	PROPELLANT TESTS		
643 10 02	Laser Propulsion	506 55 19	
POSITIVE IONS			
Aeronomy Energy Deposition	W81 70470	W81-70229	
154 70 80			
POSTFLIGHT ANALYSIS			
Operational Laboratory Support			
199-10 10			
Crew Health Maintenance			
199 10 30			
POWER METALLURGY			
Metallic/Ceramic Materials			
505 33-12			
Advanced Aluminum Alloys			
505-33-13			
POWER CONDITIONING			
Advanced Energetics			
506 55-12			
PROPELLANT PLANNING			
Ocean Thermal Energy Conversion Study and Assessment			
776 91 40			
PROPELLERS			
Cosmic Background Explorer (COBE)			
685-20 08			
PROPAGATION MODES			
Laser/VLBI Propagation Medium Analysis			
676 59 35			
PROPELLANT TESTS			
Laser Propulsion			
506 55 19			
PROTEC			
Protective Coatings			
Metallic/Ceramic Materials			
505-33-12			
PROTECTIVE COATINGS			
Metallic/Ceramic Materials			
505-33 12			

PROTOSTARS			
Formation Evolution and Stability of Proto Stellar Disks	153 01-60	W81 70446	Terrain Models for SAR Development
Demonstration Flight System and Operational Land Observing System (OLOS)	677 29-06	W81-70416	677 43 01
Interdisciplinary Research	199 90 71	W81-70547	Extended Scene Radar Calibration
PSYCHOLOGICAL EFFECTS			677 47-02
Human Response to Noise	505 35 13	W81-70055	NASA Airborne Imaging Radar Facility
Man-Machine Systems	199 60-60	W81 70543	677 47 03
PULSARS			Seasat Digital SAR Processing (Renewable Resources)
Radar Astronomy	188-41 55	W81 70507	677-76 01
Technical Consultation Services	643-10-01	W81 70375	Radar Studies
PULSE COMMUNICATION			153 07 70
Decoupler Pylon Flight Demonstration	506-61 36	W81 70256	RADAR MEASUREMENT
Flight Loads and Aeroelasticity	533-02 73	W81 70155	Radar Spectrometer
PYLONS			677 27 04
Decoupler Pylon Flight Demonstration	505 33 54	W81-70041	RADAR SCATTERING
Flight Loads and Aeroelasticity	533-02-73	W81 70155	Microscale Ocean Surface Dynamics
QUALITATIVE ANALYSIS			146-40 05
Planetary Materials Laboratory and Analytical Studies	152 02-40	W81-70443	RADAR SIGNATURES
QUANTITATIVE ANALYSIS			Rock Type/Microwave Techniques (Imaging Radar Geology)
Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere	147 20 03	W81 70359	677 41-04
QUASARS			RADAR TRACKING
Radio Metric Analysis Demonstration and Instrumentation Development	310 10 60	W81 70575	Planetary Geology
QUIET ENGINE PROGRAM			151 01-70
Quiet Propulsive-Lift Technology Experiments Aircraft Performance and Operating Systems Research	532 02 11	W81 70134	RADAR TRANSMITTERS
QPLT Systems Technology	532 02 12	W81 70135	Advanced Synthetic Aperture Radar Technology
R			506-61 37
RADAR			RADIAL FLOW
Remote Sensing of Air Sea Interactions Phenomena	146 40 05	W81 70335	Fan Compressor and Turbine Research
Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	637 01 03	W81-70382	505 32 22
Extended Scene Radar Calibration	677 47 02	W81 70433	RADIAL VELOCITY
RADAR ANTENNAS			Detection of Other Planetary Systems
RFI Systems Technology	310 30 69	W81 70588	196-41 68
RADAR APPROACH CONTROL			RADIATION ABSORPTION
Interagency and Industrial Assistance and Testing	505 43 31	W81 70096	Laser Propulsion
RADAR ASTRONOMY			506-55 19
Ground Based Radio and Radar Planetary Astronomy	196 41 85	W81 70532	RADIATION BELTS
General Aviation Aircraft Aerodynamics and Flight Dynamics	505 41 18	W81-70072	Radio and Radar Planetary Studies
Radar Studies	153-07 70	W81 70453	196-41 51
High Speed Signal Processing Research	310 30-70	W81 70589	RADIATION DAMAGE
RADAR IMAGERY			Solar Cell Technology
Advanced Synthetic Aperture Radar Technology	506 61-37	W81 70257	506-55 42
Microscale Ocean Surface Dynamics	146 40 05	W81-70333	Solar Cell Research
Ocean Wave Height Determination with the Synthetic Aperture Radar	146 40 05	W81-70334	506-55 43
Severe Storms and Local Weather Research	146 50 02	W81 70344	Instrument Definition
Synthetic Aperture Radar Processor	656 62-01	W81 70400	157 03 01
Integration of VIS IR-NW Data	677 21 06	W81 70410	Advanced Technological Development
Rock Type/Microwave Techniques (Imaging Radar Geology)	677 41-04	W81 70419	General Signal and Data Processing Electronics
Analysis of Multifrequency/Multipolarization SAR Imagery	677 41 12	W81 70423	Solid State Detectors
			188 78 51
RADIATION DETECTORS			188 78-51
Advanced Technological Development	506 55 45	W81 70235	RADIATION DOSAGE
Composites for Advanced Space Systems	506 53-23	W81 70192	Planetary Solar Array Research and Technology
Fundamental Electronics	506 54 65	W81 70217	506 55 45
Solar Cell Research	506 55 43	W81 70234	RADIATION EFFECTS
Radiation Effects and Protection RTOP	199 20 70	W81 70541	Composites for Advanced Space Systems
In Situ Instrumentation for Developing Nuclear Waste Isolation Sites	775-16 27	W81-70298	506 53-23
Global Terrestrial Ecology	199 70 31	W81 70546	Fundamental Electronics
RADIATION MEASUREMENT			506 54 65
In Situ Instrumentation for Developing Nuclear Waste Isolation Sites	775-16-27	W81-70298	Solar Cell Research
RADIATION MEASURING INSTRUMENTS			506 55 43
In Situ Instrumentation for Developing Nuclear Waste Isolation Sites	775-16-27	W81 70298	RADIATION HAZARDS
Stratospheric Research Field Measurements Program	147 10-02	W81 70298	Radiation Effects and Protection RTOP
X Ray Gamma Ray and Neutron Gamma-Ray Methods for Planetary Exploration	197 03 50	W81 70354	199 20 70
Particle Astrophysics	188 46 56	W81 70489	RADIATION PROTECTION
Radiation Effects and Protection RTOP	199 20 70	W81 70508	Radiation Effects and Protection RTOP
RADIATION SHIELDING			199 20 70
Radiation Effects and Protection RTOP	199 20 70	W81 70541	RADIATION SOURCES
RADIATION SPECTRA			Particle Astrophysics and Shuttle Experiment Definition
Remote Sensing	153 07 40	W81-70452	188 46 56
RADIATIVE TRANSFER			RADIATION SPECTRA
Aerosol Climatic Effects Special Study	146 10 04	W81 70325	Remote Sensing
Radiation Budget and Aerosol Studies	146 10 06	W81-70326	153 07 40
Great Lakes Water Quality Research	146-40 18	W81-70343	RADIATION TRANSFER
			Aerosol Climatic Effects Special Study
			Radiation Budget and Aerosol Studies
			Great Lakes Water Quality Research
			146-40 18
REMOTE SENSING			REMOTE SENSING
Planetary Atmospheric Composition and Structure	153 07 40	W81 70452	153 07 40
Planetary Clouds Particulates and Ices Clouds of Venus	154 10 80	W81 70457	154 10 80
Radiative Transfer in Cloudy Atmosphere	154 30 80	W81 70462	154 40 80
Theoretical Studies of Galaxies Active Galactic Nuclei and Quasi Stellar Objects	154 41-51	W81 70464	188 41-51
RADIO ASTRONOMY			W81-70503
Cosmic Chemistry Aeronomy Comets Grains	154 75-80	W81 70471	RADIO ASTRONOMY
Infrared and Radio Astronomy	188 41-55	W81-70505	188 41-55
Theoretical Infrared and Radio Astrophysics	188-41 55	W81 70506	Radio Astronomy
Radio and Radar Planetary Studies	196 41-51	W81 70521	188 41 55
Ground-Based Radio and Radar Planetary Astronomy	196 41-85	W81 70532	Radio and Radar Planetary Studies
Station Monitor and Control Technology	310 30 68	W81 70587	196 41-51
RADIO COMMUNICATION			Ground-Based Radio and Radar Planetary Astronomy
Commercial Fisheries Ocean Forecast Demonstration	663 90 03	W81 70401	310 20 66
Radio Systems Development	310 20 66	W81 70585	Telemetry Technology Development
			310 20 67
			310 30 68
RADIO FILTERS			310 30 68
Signal Detection and Processing Filters and Receivers	506 54 56	W81 70213	RADIO FILTERS
RADIO FREQUENCIES			Signal Detection and Processing Filters and Receivers
High Speed Data Transfer S/K Band Components and Techniques	506 61 26	W81 70252	506 54 56
30/20 GHz Spacecraft Multibeam Antenna Technology	650-60-20	W81 70386	30/20 GHz Spacecraft Multibeam Antenna Technology
Technology for TDRSS User Spacecraft	310 20 46	W81 70582	Technology for TDRSS User Spacecraft
RADIO FREQUENCY INTERFERENCE			310 20 46
Remote Sensing Frequency Coordination Studies	643 10 04	W81 70380	RADIO FREQUENCY INTERFERENCE
RFI Systems Technology	310 30 69	W81 70588	Remote Sensing Frequency Coordination Studies
High Speed Signal Processing Research	310-30 70	W81 70589	RFI Systems Technology
RADIO INTERFEROMETERS			High Speed Signal Processing Research
VLBI Development and Analysis	310 10-61	W81 70576	310 30 69
RADIO NAVIGATION			310 30 70
High Speed Data Transfer X/S Band Components	506 61 25	W81 70251	RADIO NAVIGATION
Radio Metric Analysis Demonstration and	506 61 25	W81 70251	High Speed Data Transfer X/S Band Components
Instrumentation Development	310 10 60	W81 70575	Radio Metric Analysis Demonstration and
Frequency and Timing Research	310 10 62	W81 70577	Instrumentation Development
Navigation Technology Development	310 10 63	W81 70578	Frequency and Timing Research
RADIO SOURCES (ASTRONOMY)			Navigation Technology Development
Radio Astronomy	188 41 55	W81 70507	310 10 63
RADIO TRACKING			RADIO SOURCES (ASTRONOMY)
Mars Data Analysis Astronomy	155 41 80	W81 70482	Radio Astronomy
RADIO TRANSMISSION			188 41 55
Systems Coordination Support	643 10 03	W81 70379	RADIO TRACKING
GHz Wideband Communications Satellite Project	650-60 18	W81 70385	Mars Data Analysis Astronomy
Definition	30/20 GHz Spacecraft Multibeam Antenna Technology	W81 70386	155 41 80
	650 60 20	W81 70386	RADIO TRANSMISSION
RADIO WAVES			30/20 GHz Spacecraft Multibeam Antenna Technology
Ground-Based Radio and Radar Planetary Astronomy	196 41 85	W81-70532	650 60 20
RADIOACTIVE WASTES			RADIO WAVES
In Situ Instrumentation for Developing Nuclear Waste Isolation Sites	775 16 27	W81 70298	Ground-Based Radio and Radar Planetary Astronomy
			196 41 85
RADIOBIOLOGY			RADIOACTIVE WASTES
Radiation Effects and Protection RTOP	199 20 70	W81-70541	In Situ Instrumentation for Developing Nuclear Waste Isolation Sites
RADIOMETERS			775 16 27
Sensor Systems	506 61-36	W81-70256	RADIOBIOLOGY
Radiation Budget and Aerosol Studies	146 10 06	W81 70326	Radiation Effects and Protection RTOP
Global Tropospheric Models Monitoring	146 20 08	W81 70327	199 20 70
Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring	146 20 10	W81-70328	Global Tropospheric Models Monitoring
Remote Sensing of Air-Sea Interactions Phenomena	146 40 05	W81-70335	Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring
Microwave Remote Sensing for Ice Processes Research	146-40 06	W81-70336	Remote Sensing of Air-Sea Interactions Phenomena

SUBJECT INDEX

Advanced Ocean Sensor Systems Development	WB1 70340
Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	
637-01 03	WB1-70382
Laser/VLBI Propagation Medium Analysis	
676 59 37	WB1 70408
Development of Experiments and Hardware for Solar Physics Research	
170-38 51	WB1-70495
Radio Systems Development	
310 20 66	WB1 70585
RADIOSONDES	
Aviation Meteorology Research Atmospheric Dynamics & Measurement Tech	
505 44 18	WB1 70105
RAIN	
Very Low Cost Data System	16-Bit
Microprocessor Driven ELAS	
677 76 04	WB1 70437
RAMJET ENGINES	
High Temperature Aeronautical Structures	
505-33 73	WB1 70046
RANGEFINDING	
Station Monitor and Control Technology	
310 30 68	WB1 70587
RANKINE CYCLE	
Solar Rankine Cycle Applications Study	
776 91 59	WB1 70303
REACTION KINETICS	
Upper Atmosphere Research	Laboratory
Measurements	
147 20 01	WB1 70357
Chemical Kinetics	
147 20 01	WB1 70358
Stratospheric Theoretical Studies and Science Definition Activities	
147 30 01	WB1 70361
Cosmic Chemistry Aeronomy Comets Grains	
154 75 80	WB1 70471
REACTOR SAFETY	
Pipeline/Nuclear Plant Engineering Geology	
677 44 01	WB1 70428
READOUT	
Remote Sensing Frequency Coordination Studies	
643 10-04	WB1 70380
REAL GASES	
Space Vehicle Aerothermodynamics and Configuration Technology	
506 51 13	WB1 70174
REAL TIME OPERATION	
Infrared Detectors Far IR Sensors	
506 61 31	WB1 70253
NASA End to End Data System Information Adaptive System	
506 61-53	WB1-70260
NASA End to End Data System (NEEDS) Phase 2	
506 61 56	WB1 70262
RECEIVERS	
High Speed Data Transfer S/K Band Components and Techniques	
506 61-26	WB1-70252
Communications System Components	
650 60 22	WB1-70388
Network Systems Technology Development	
310-20-33	WB1-70580
RECRYSTALLIZATION	
Experimental Magnetism	
153 08-50	WB1 70454
REDUCED GRAVITY	
Liquid Chemical Propulsion Technology	
506-52 12	WB1-70180
Semiconductor Materials Growth in Low-g Environment	
542 03-30	WB1 70294
Cryogenic Fluid Management	
542-03 52	WB1-70295
Infrared Detector Materials Preparation	
179-80-10	WB1-70372
Low Gravity Superfluid Helium Advanced Technology Development	
188 78 51	WB1 70515
REDUNDANCY	
Aircraft Controls Reliability Enhancement	
505-34 31	WB1 70049
Aircraft Controls Flight Systems Concepts	
505-34-34	WB1 70052
REDUNDANCY ENCODING	
Aircraft Controls Reliability Enhancement	
505-34 31	WB1 70049
REDUNDANT COMPONENTS	
Integrated Avionic Control Systems for Rotorcraft	
505 42 31	WB1 70085
Advanced Guidance and Control Systems Validation Technology	
512 54-11	WB1 70124
REENTRY	
Space Shuttle Aerodynamic Experiments	
506-51 34	WB1 70179
REENTRY EFFECTS	
Space Vehicle Aerothermodynamics and Configuration Technology	
506-51 13	WB1 70174

REENTRY SHIELDING	
Thermal Protection Systems Materials and Systems Evaluation	
506 53-31	WB1 70195
OEX Thermal Protection Experiments	
506 63-36	WB1 70275
REENTRY TRAJECTORIES	
Aerodynamic/Aerothermodynamic Flight Data Analysis	
506 51-33	WB1 70178
REFLECTORS	
Earth Satellite Communication Antenna Development	
541 02-15	WB1-70288
REFRIGERATING	
Waste Heat Automotive Air Conditioner	
778 48-17	WB1-70312
REFRIGERATORS	
Radio Systems Development	
310-20-66	WB1 70585
REGOLITH	
Theoretical Studies of Radar Backscatter	
677-41 11	WB1-70422
Mars Data Analysis Studies	
155-20-70	WB1-70481
RELIABILITY	
Systems Habitability Verification	
199-10-41	WB1-70537
RELIABILITY ANALYSIS	
Advanced Guidance and Control Systems Validation Technology	
512-54-11	WB1 70124
Advanced Guidance and Control Flight Systems Experiments	
512-54 14	WB1 70125
Ion Thruster Research and Ion Beam Applications	
506-55 32	WB1-70231
RELIABILITY ENGINEERING	
Aircraft Controls Flight Systems Concepts	
505-34 34	WB1 70052
Integration and Interfacing Technology	
505-34 43	WB1-70054
Fundamental Electronics	
506-54 65	WB1 70217
Advanced Power System Technology	
506-55 78	WB1 70242
REMOTE CONSOLES	
Full Scale Applications Data Service (ADS) Planning Studies	
656-13 20	WB1 70392
REMOTE CONTROL	
Remotely Piloted Research Aircraft Technology	
505 43 44	WB1 70099
Advanced Teleoperation Studies	
199-60 80	WB1 70545
Frequency and Timing Research	
310 10 62	WB1 70577
Station Monitor and Control Technology	
310-30 68	WB1 70587
REMOTE SENSORS	
Quantum Electronics Devices and Sensors	
506 54 43	WB1 70209
Quantum Electronics Sources	
506 54 45	WB1 70210
Fund for Independent Research	
506 55 16	WB1 70247
Sensor Systems Technology	
506 61 33	WB1 70254
Remote Sensing Systems	
506 61 35	WB1 70255
NASA End-to-End Data System Information Adaptive System	
506 61 53	WB1 70260
Infrared Imagery of Shuttle	
506 63 35	WB1 70274
Information Systems for Earth Observations for Space	
540 01-13	WB1 70277
Remote Sensing of Subsurface Drain Malfunctions	
141 20 21	WB1 70317
Ocular Screening System	
141 95-02	WB1 70321
Seasat Data Utilization Project	
146 01-00	WB1 70322
Climate Research	
146 10-03	WB1 70324
Radiation Budget and Aerosol Studies	
146 10-06	WB1 70326
Global Tropospheric Models Monitoring	
146 20-08	WB1 70327
Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring	
146 20-10	WB1 70328
THEORETICAL STUDIES OF THE UPPER TROPOSPHERIC AEROSOL LAYER AND SAHARA DUST	
146 20-23	WB1-70329
Global Weather Research	
146 30-02	WB1 70330
Global Weather Research	
146 30-02	WB1 70331
Microscale Ocean Surface Dynamics	
146 40-05	WB1-70333
Remote Sensing of Air-Sea Interactions Phenomena	
146 40-05	WB1 70335
Microwave Remote Sensing for Ice Processes Research	
146-40-06	WB1-70336
Ocean Circulation and Topography	
146-40-07	WB1-70337

RESEARCH MANAGEMENT

Advanced Ocean Sensor Systems Development	WB1-70339
Advanced Ocean Sensor Systems Development	WB1-70340
Coastal and Estuarine Dynamic Processes Research	WB1 70341
Coastal and Estuarine Dynamic Processes Research	WB1 70342
Great Lakes Water Quality Research	
146-40 18	WB1-70343
Severe Storms and Local Weather Research	
146-50-02	WB1 70344
Stratospheric Measurement Program Activities	
146-60-01	WB1-70347
Environmental Monitoring Research Satellite Mission Studies	
146-60 02	WB1-70349
Upper Atmosphere Research - Field Measurements	
147-10 01	WB1-70352
Stratospheric Research Field Measurements Program	
147 10 02	WB1-70354
Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere	
147 10 02	WB1-70355
Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere	
147 20 03	WB1 70359
Remote Sensing Frequency Coordination Studies	
643 10 04	WB1 70380
Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	
637 01 03	WB1-70382
ADS Oceanic Pilot System Project	
656-13 40	WB1 70394
Automated Mosaicking for Geocoded Data Bases	
656 33 01	WB1-70398
Registration of Radar and Other Data	
656-45 02	WB1 70399
Surface Mine Rehabilitation Inventory and Monitoring	
677 21 20	WB1-70411
Remotely Sensed Electromagnetic Characteristics of Snow and Soil Moisture	
677-22 12	WB1-70413
Phase B Studies Landsat Solid-State Sensor (LS3)	
677 29 09	WB1 70417
NASA/Geosat Test Case Study	
677 41 02	WB1-70418
High Spectral Resolution Remote Sensing	
677-41 08	WB1 70420
Geological Mapping Kilauea Caldera Stratigraphy	
677 41 09	WB1 70421
Geobotanical Test Site Investigations	
677 42 01	WB1 70424
Integrated Study of Continental Rift Systems	
677 43 05	WB1 70427
Pipeline/Nuclear Plant Engineering Geology	
677 44-01	WB1-70428
Aircraft Thermal Infrared Scanner	
677 47 01	WB1 70432
Multispectral Linear Arrays for the Short-Wave Infrared (MLA/SWIR)	
677 77 01	WB1 70438
Remote Sensing	
153 07 40	WB1 70452
Atmospheric Experiment Development	
154 90 80	WB1 70476
Instrument Definition	
157 03-01	WB1 70487
X Ray Gamma Ray and Neutron Gamma Ray Methods for Planetary Exploration	
157-03 50	WB1 70489
Remote Sensing Of Planetary Surfaces	
196 41-40	WB1 70519
REMOTELY PILOTED VEHICLES	
Flight Loads and Aeroelasticity	
505 33-54	WB1 70041
Human Factors Flight Research with High Performance Aircraft and RPVs	
505 35 24	WB1 70058
Remotely Piloted Research Aircraft Technology	
505 43-44	WB1 70099
REPRODUCTION (COPYING)	
Data Reproduction in Support of the Mars Data Analysis Program	
155 50 01	WB1 70484
RESCUE OPERATIONS	
Wallops Flight Center Research Airport Support	
534 04-18	WB1 70165
RESEARCH AIRCRAFT	
Integrated Research Aircraft Control Technology	
533 02 44	WB1 70153
RESEARCH FACILITIES	
JSC General Operations - Geophysics and Geochemistry	
153-10 40	WB1 70456
RESEARCH MANAGEMENT	
Funds for Independent Research (Aeronautics)	
505 36-11	WB1 70061
Fund for Independent Research (Aeronautics)	
505 36 12	WB1 70062
Fund for Independent Research (Aeronautics)	
505 36-13	WB1-70063
Funds for Independent Research	
505 36 14	WB1 70064

Chemical Propulsion Research Support	W81 70184	Advanced Rotorcraft Systems Technology Materials and Noise	W81 70142	Severe Storms and Local Weather Research
506 52-30		532 06-13		146 50 02
Funds for Independent Research (Space)	W81 70244	ROTARY WINGS		W81 70344
506-56-11		Rotocraft Aeroelasticity and Structural Dynamics		Upper Atmosphere Research Satellites (UARS) Definition
Fund for Independent Research (Space)	W81 70245	505-42 11	W81 70081	Study
506-56-12		Rotocraft Structures Vibration Aeroelasticity and Acoustics		147-40 01
Fund for Independent Research (Space)	W81 70246	505-42-13	W81 70082	Solar Physics Data Analysis and Operations
506 56 13		Rotocraft Aerodynamic Performance Dynamics and Handling Qualities		385-38 01
JSC General Operations Geophysics and Geochemistry	W81 70456	505 42-21	W81 70083	High Energy Astrophysics Data Analysis
153 10 40		Rotocraft Aerodynamics Scale Modeling		389 46-01
Interdisciplinary Space Science Research	W81 70514	505 42 23	W81 70084	Theoretical High Energy Astrophysics
188 48 51		ROTATING LIQUIDS		389 46-03
RESINS		Development of a Shuttle Flight Experiment Drop Dynamics Module		W81 70583
Composites	W81 70038	542-03 01	W81 70289	SATELLITE ORBITS
505-33-33		ROTOR AERODYNAMICS		Environmental Monitoring Research Satellite Mission Studies
RESOURCES MANAGEMENT		Airfoil Development		146-60 02
Integration of VIS-IR-NW Data	W81 70410	505-31-33	W81 70006	SATELLITE SOLAR POWER STATIONS
677-21 06		Loads Dynamics and Aeroelasticity		Advanced Energetics
Very Low Cost Data System	16 Bit	505 33 52	W81 70039	506-55 12
Microprocessor Driven ELAS	W81 70437	Rotocraft Aeroelasticity and Structural Dynamics		W81 70226
677-76 04		505 42 11	W81 70081	SATELLITE SOUNDING
RETURN BEAM VIDICONS		Rotocraft Structures Vibration Aeroelasticity and Acoustics		Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere
Tectonic Structure in Pakistan	W81 70426	505-42 13	W81 70082	147 10 02
677-43-03		Rotocraft Aerodynamic Performance Dynamics and Handling Qualities		SATELLITE TRANSMISSION
REUSABLE ROCKET ENGINES		505-42 21	W81 70083	Technical Consultation Services
Advanced Reusable Main Engine Technology	W81 70182	Rotocraft Aerodynamics Scale Modeling		643 10 01
506-52 19		505 42 23	W81 70084	Communication Satellite Application Systems
REYNOLDS NUMBER		ROTOR LIFT		643 10 02
Aeronautics Flight Experiments	W81 70009	Heavy Lift/Short Haul Hybrid Airship Technology		Systems Coordination Support
505-31 44		505 42 51	W81 70086	643 10 03
Full Space Reynolds Number Test Technology	W81 70013	ROTOR SYSTEMS RESEARCH AIRCRAFT		W81 70379
505 31 63		Advanced Rotor Systems Technology/RSRA		SATELLITE-BORNE INSTRUMENTS
REYNOLDS STRESS		Operations		Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere
Aerodynamic Test Methods and Instrumentation	W81 70010	532-03 11	W81 70136	147-10 02
505 31-51		ROTORCRAFT AIRCRAFT		SATELLITE BORNE PHOTOGRAPHY
Aviation Safety Technology Applied Fluid Mechanics	W81 70110	Rotocraft Aeroelasticity and Structural Dynamics		Tectonic Structure in Pakistan
505-44-25		505 42-11	W81 70081	677 43 03
Regional Crustal Deformation Modeling	W81 70402	RUNWAY CONDITIONS		Pipeline/Nuclear Plant Engineering Geology
676-10 10		Aircraft Systems Operational Safety and Efficiency Improvement		677-44 01
RIDING QUALITY		505-44 31	W81 70114	SATELLITE TO-SATELLITE TRACKING
Flight Dynamics and Handling Qualities	W81 70092	Aircraft Landing Systems Efficiency Improvements		Gravity Field Survey Mission (GRAVSAT) Phase B
505 43 14		505 44 33	W81 70116	Studies
RIO GRANDE (NORTH AMERICA)		S		677 29 04
Integrated Study of Continental Rift Systems	W81-70427	SAFETY		W81 70415
677 43-05		Post Spill Liquid Hydrogen Behavior		SATURN (PLANET)
Crustal Modeling Using Satellite Potential Field Data	W81 70429	505 31 70	W81 70014	Planetary Dynamics
677 45-01		SAFETY FACTORS		153 05 70
RISK		Aerial Applications Aerodynamics and Systems Interaction		Clouds Particulates and Ices
Demonstration Flight System and Operational Land Observing System (OLOS)	W81 70416	505 41 83	W81 70080	154 30 80
677-29-06		SAGE SATELLITE		SATURN ATMOSPHERE
ROBOTS		Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere		Optical Astronomy
Robotics/Machine Intelligence Automated Systems	W81 70223	147 10 02	W81 70355	196 41 71
506 54 85		SALINITY		Planetary Infrared Imaging
Space Applications of Automation Robotics and Machine Intelligence Systems (ARAMIS	W81 70283	Advanced Ocean Sensor Systems Development		196 41 77
540 02 19		146 40 13	W81 70340	Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn
ROCKET ENGINE DESIGN		SAMPLES		385 36-04
Laser Propulsion	W81-70229	Curation of Extraterrestrial Samples		W81 70558
506 55-19		152-04 40	W81 70444	SATURN RINGS
ROCKET ENGINES		Mars Data Analysis Program Geology		Radiative Transfer in Cloudy Atmosphere
MPD Thruster System Technology	W81 70232	155-50 01	W81 70483	154 40 80
506 55 35		SATELLITE ATMOSPHERES		Planetary Infrared Imaging
ROCKET BORNE INSTRUMENTS		Planetary Aeronomy Theory and Analysis		196-41 77
Improved Measurement and Calibration Techniques for Stratospheric Trace Species	W81 70348	154-60 80	W81 70467	SCANNERS
146-60 01		Aeronomy of Planetary Atmospheres Chemistry		Advanced Synthetic Aperture Radar Technology
Sounding Rockets Magnetospheric Physics Experiments	W81 70568	154 75 80	W81-70257	506 61-37
828 11 36		SATELLITE DESIGN		Coastal and Estuarine Dynamic Processes Research
Sounding Rockets Experiment	W81 70569	Upper Atmosphere Research Satellites (UARS) Definition Study		146 40-15
828 11 38		147 40-01	W81 70365	SCATHA SATELLITE
Sounding Rocket Experiments (High Energy Astrophysics)	W81-70570	Extreme Ultraviolet Explorer		Magnetospheric Data Analysis
879 11-46		685-20 06	W81 70565	385 36-01
Sounding Rockets Experiments (Astronomy)	W81-70571	SCATTERING		W81 70464
879 11-41		154-60 80	W81 70487	Instrument Definition
ROCKS		Aeronomy of Planetary Atmospheres Chemistry		154 02 01
NASA/Geosat Test Case Study	W81 70418	154 75 80	W81 70489	X-Ray Gamma Ray and Neutron Gamma Ray Methods for Planetary Exploration
677-41-02		SCATTERING CROSS SECTIONS		157 03 50
Rock Type/Microwave Techniques (Imaging Radar Geology)	W81 70419	154-60 80	W81 70489	157 03 50
677-41 04		SCATTEROMETERS		W81 70488
High Spectral Resolution Remote Sensing	W81 70420	Advanced Scene Radar Calibration		Microwave Remote Sensing for Ice Processes Research
677-41 08		147 40-01	W81-70433	146-40 06
Geological Mapping Kilauea Caldera Stratigraphy	W81 70421	685-20 06	W81-70336	Scatterometer Data Analysis
677 41 09		SCHEDULING		146-40 12
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies	W81-70430	147 40-01	W81 70338	Extended Scene Radar Calibration
677 45-03		Extreme Ultraviolet Explorer		677-47-02
Aircraft Thermal Infrared Scanner	W81 70432	685-20 06	W81-70433	SCHEDULING
677-47-01		SCATTERING		Autonomous Process Control Technology for Earth Orbital Missions
ROTARY WING AIRCRAFT		147 40-01	W81 70221	506-54 76
Airfoil Development	W81 70006	W81 70365	SCHLIEREN PHOTOGRAPHY	W81 70221
505-31 33		685-20 06	Basic Noise Research	505 32 05
Rotocraft Aeroelasticity and Structural Dynamics	W81 70081	W81 70565	Cometary Observation and Theory	W81 70019
505 42 11		SCHMIDT CAMERAS		196-41 30
Integrated Avionic Control Systems for Rotocraft	W81 70085	154-60 80	196-41 30	196 41 30
505 42 31		SCIENTISTS		W81 70518
Rotocraft Operating Systems Technology	W81 70133	154-60 80	JSC General Operations - Geophysics and Geochemistry	532 06-12
532 01-11		SEA STATES		153-10-40
Advanced Rotocraft Propulsion Technology	W81-70141	154-60 80	Ocean Wave Height Determination with the Synthetic Aperture Radar	W81-70456
532 06-12		SEALERS		146 40 05
		154-60 80	Scatterometer Data Analysis	W81 70338
		154-60 80	146 40 12	146 40 12
		154-60 80	SEALERS	Fuel Tank Sealants
		154-60 80	533 01 11	W81-70143

SUBJECT INDEX

SEALS (STOPPERS)		SHORT WAVE RADIATION		SOLAR PHYSICS
Power Transfer Research		Multispectral Linear Arrays for the Short-Wave Infrared (MLA/SWIR)		Solar Cell Technology
505-32-42	W81 70024	677-77 01	W81-70438	506 55-42
Sensor Cooling System				Solar Cell Research
506-61-46	W81 70259			506-55 43
SEASAT PROGRAM		SIGNAL DETECTION		Planetary Solar Array Research and Technology
Seasat Data Utilization Project		Signal Detection and Processing	Filters and Receivers	506-55 45
146 01-00	W81-70322	506-54 56	W81-70213	Space Calibration of Solar Cells
Synthetic Aperture Radar Processor		Signal Processing and Detection	High-Density Circuit	542-03 20
656 62-01	W81 70400	Technology		W81 70292
Commercial Fisheries Ocean Forecast Demonstration		506-54 59	W81-70214	SOLAR CELLS
663 90-03	W81-70401	Arrayed Network Technology		Solar Cell Technology
Seasat Digital SAR Processing (Non-Renewable Resources)		310-40 74	W81-70597	506 55-42
677 48-01	W81 70435			Solar Cell Research
SEASAT SATELLITES		SIGNAL PROCESSING		506-55 43
Ocean Circulation and Topography		Signal Detection and Processing	Filters and Receivers	Planetary Solar Array Research and Technology
146-40-07	W81 70337	506-54-56	W81 70213	506-55 45
Integration of VIS-IR-NW Data		Signal Processing and Detection	High-Density Circuit	Space Calibration of Solar Cells
677 21-06	W81 70410	Technology		542-03 20
SEASAT-A SATELLITE		506-54 59	W81-70214	W81 70292
Seasat Data Utilization Project		Arrayed Network Technology		SOLAR COLLECTORS
146 01 00	W81 70322	310-40 74	W81-70597	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)
Microwave Remote Sensing for Ice Processes Research				776-91 19
146 40 06	W81 70336	SIGNAL MIXING		W81 70300
SEATS		Signal Detection and Processing	Filters and Receivers	SOLAR CORONA
Fire Systems Full Scale Test		506-54-56	W81 70213	Formation Evolution and Stability of Proto-Stellar Disks
534 05 17	W81 70166	Signal Processing and Detection	High-Density Circuit	153 01 60
SELF ADAPTIVE CONTROL SYSTEMS		Technology		Mars Data Analysis Astronomy
Autonomous Process Control Technology for Earth Orbital Missions		506-54 59	W81-70214	155-41 80
506 54-76	W81 70221	Ocean Wave Height Determination with the Synthetic Aperture Radar		Development of Solar Spacelab Experiment and Hardware
SEMICONDUCTOR DEVICES		146-40 05	W81-70334	170 38 51
Fundamental Electronics		Technical Consultation Services		Experiment Development Laboratory and Theoretical Solar Physics
506 54-65	W81 70217	643-10 01	W81-70375	170-38 53
SEMICONDUCTOR LASERS		Systems for Underwater Survey and Exploration (SUSE)		Advanced Mission Study Solar X Ray Pinhole Satellite and Long Focal Length Coronagraph
Data Transmission and Processing Research		637 01 02	W81-70589	356-38-01
506 54 55	W81 70212	Advanced Technological Development General Signal and Data Processing Electronics	W81-70516	Sounding Rockets Experiment
Advanced Electronic Components		Solid State Detectors		828-11 38
506-54 63	W81 70216	High Speed Signal Processing Research		W81-70569
SEMICONDUCTORS (MATERIALS)		310-30 70	W81-70589	SOLAR ELECTRIC PROPULSION
Surface Physics and Computational Chemistry		SIGNAL TO NOISE RATIOS		Solar Cell Research
506 53 11	W81 70188	High Speed Data Transfer S/K Band Components and Techniques		506-55-43
Semiconductor Materials Growth in Low-g Environment		506-61 26	W81-70252	Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array
542 03 30	W81 70294	SIGNAL TRANSMISSION		542-03 04
Infrared Detector Materials Research		Network Timing and Synchronization Technology		W81 70290
179 80 10	W81 70371	310-20 27	W81-70579	SOLAR ENERGY
Infrared Detector Materials Preparation		SILICATES		Solar Cell Technology
179 80 10	W81 70372	Aircraft Thermal Infrared Scanner		506-55 42
SENSORY PERCEPTION		677 47 01	W81-70432	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)
Simulation Technology for Aeronautics		Remote Sensing Of Planetary Surfaces		776-91 19
505 35-31	W81 70059	196-41 40	W81-70519	W81 70300
SEPARATED FLOW		SILICON		SOLAR ENERGY CONVERSION
Turbulent Drag Reduction		Refining of Nonterrestrial Materials		Advanced Radiant Energy Conversion
505 31 23	W81 70004	506-53 17	W81 70191	506-55 13
Airfoil and Wing Development		Solar Cell Technology		Advanced Energy Technology
505 31 31	W81 70005	506-55 42	W81 70233	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)
Aeronautics Flight Experiments		Planetary Solar Array Research and Technology		776-91 19
505 31 44	W81 70009	506-55 45	W81-70235	W81 70300
SEPARATORS		SILICON CARBIDES		SOLAR FLARES
Materials Science		Metallic/Ceramic Materials		Development of Solar Spacelab Experiment and Hardware
506 53 12	W81 70189	505 33 12	W81-70031	170-38-51
SEQUENCING		Metallic/Ceramic Materials		Advanced Mission Study Solar X-Ray Pinhole Satellite and Long Focal Length Coronagraph
Automation of Space Mission Uplink Process Control		505 33-12	356-38-01	W81-70549
506 54 75	W81 70220	SILICON NITRIDES		
SERVICE LIFE		Metallic/Ceramic Materials		SOLAR GENERATORS
Helicopter Transmission Technology		179 80-10	W81 70371	Thermal-Electric and Thermionic Energy Conversion Technology
511-58 12	W81 70122	Infrared Detector Materials Research		506-55-65
SERVOMECHANISMS		179 80-10	W81 70372	Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)
Intelligent Systems Research		SITES		776-91-19
506-54 83	W81 70222	Pipeline/Nuclear Plant Engineering Geology		W81-70300
SHAFTS (MACHINE ELEMENTS)		677-44-01	W81 70428	SOLAR FLUX
Power Transfer Research				Ozone Data Reduction and Analysis and Solar UV Variability
505 32 42	W81 70024	SKID LANDINGS		146-60 01
SHALE OIL		Aircraft Landing Systems Efficiency Improvements		W81 70346
Fuels Research		505 44-33	W81 70116	Development of Experiments and Hardware for Solar Physics Research
505 32 72	W81 70027	SNOW		170-38 51
SHEEP		Remotely-Sensed Electromagnetic Characteristics of Snow and Soil Moisture		W81-70495
Bioseparation		677 22-12	W81-70413	Development of Experiments and Hardware for Solar Physics Research
179-80 80	W81 70374	SOIL MOISTURE		170-38-52
SHELL STABILITY		Climate Research		W81-70498
Fusion Target Technology Study		146 10-03	W81-70324	Data Analysis Solar Physics
179 20 57	W81 70369	Remotely Sensed Electromagnetic Characteristics of Snow and Soil Moisture		385-38-01
SHOCK LAYERS		677 22-12	W81 70413	W81-70560
Planetary Probe Aerothermodynamic Technology		SITES		SOLAR GENERATORS
506-51 21	W81 70175	Pipeline/Nuclear Plant Engineering Geology		Thermal-Electric and Thermionic Energy Conversion Technology
SHOCK WAVES		677-44-01	W81 70428	506-55-65
Aerodynamic Test Methods and Instrumentation				Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)
505 31-51	W81 70010	SKID LANDINGS		776-91-19
SHORT HAUL AIRCRAFT		Aircraft Landing Systems Efficiency Improvements		W81-70300
Quiet Propulsive Lift Technology Experiments Aircraft Performance and Operating Systems Research		505 44-33	W81 70116	SOLAR MAGNETIC FIELD
532-02 11	W81 70134	SNOW		Development of Experiments and Hardware for Solar Physics Research
OPLT Systems Technology		Remotely-Sensed Electromagnetic Characteristics of Snow and Soil Moisture		170-38-51
532-02 12	W81 70135	677 22-12	W81 70413	Ground Based Observations of the Sun
SHORT TAKEOFF AIRCRAFT		Extended Scene Radar Calibration		170-38-52
Quiet Propulsive Lift Technology Experiments Aircraft Performance and Operating Systems Research		677 47-02	W81 70433	W81-70498
532 02 11	W81 70134	SOILS		SOLAR PHYSICS
OPLT Systems Technology		Very Low-Cost Data System	16-Bit	Particle Accelerator Facility Maintenance and Operation of a Calibration Facility for Magnetospheric and Solar Terrestrial Experiments
532-02 12	W81 70135	Microprocessor-Driven ELAS		170-36-57
SOLAR ACTIVITY		677 76-04	W81 70437	Development of Experiments and Hardware for Solar Physics Research
Ozone Data Reduction and Analysis and Solar UV Variability		Mars Data Analysis Program		170-38-51
146 60-01	W81-70346	155 20-40	W81 70480	W81-70495
SOLAR ARRAYS		Mars Data Analysis Program Geology		Development of Solar Spacelab Experiment and Hardware
Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array		155 50-01	W81 70483	170-38-51
542 03 04	W81 70290	MDAP Geology		W81-70495
SOLAR ARRAYS		155 50-01	W81 70485	Development of Solar Spacelab Experiment and Hardware
Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array		SOLAR ACTIVITY		170-38-51
542 03 04	W81 70290	Ozone Data Reduction and Analysis and Solar UV Variability		W81-70496
SOLAR ARRAYS		146 60-01	W81-70346	Experiment Development - Laboratory and Theoretical Solar Physics
Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array		W81-70346	170-38-53	W81-70499
542 03 04	W81 70290	Spacecraft Science Payloads Definition ATD - General		356-38-01
SOLAR ARRAYS		W81 70290	W81-70550	

SOLAR RADIATION

Solar Physics Data Analysis and Operations	WB1 70559	Sounding Rocket Experiments (High Energy Astrophysics)	WB1 70570	Glass Research	WB1 70373
385 38 01		879 11-46		Bioseparation	
Data Analysis Solar Physics		Sounding Rockets Experiments (Astronomy)		179 80-80	WB1-70374
385 38-01	WB1 70560	879 11 41	WB1 70571	SPACE PROGRAMS	
SOLAR RADIATION		SPACE COMMUNICATION		Space Systems and Planning Analysis	
Ground Based Observations of the Sun		Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame		540 04-10	WB1-70286
170 38-52	WB1 70497	540 01-16	WB1 70279	SPACE SHUTTLE ORBITERS	
Imaging Studies of Comets		Technical Consultation Services	WB1-70375	Aerodynamic/Aerothermodynamic Flight Data Analysis	
196 41-52	WB1 70522	643 10-01	WB1-70375	506 51 33	WB1-70178
Sounding Rockets Experiment		Antenna Systems Development	WB1 70584	Space Shuttle Configuration and Aerothermodynamics	
828 11-38	WB1 70569	310 20-65	WB1 70584	506-63-11	WB1 70268
SOLAR SPECTROMETERS		Arrayed Network Technology		ACIP (Aerodynamic Coefficient Identification Package)	
Development of Solar Spacelab Experiment and Hardware		310 40-74	WB1 70597	506-63 27	WB1-70270
170 38-51	WB1 70496	SPACE DEBRIS		506 63-31	WB1 70271
Experiment Development - Laboratory and Theoretical Solar Physics		Satellite Services	WB1-70599	Shuttle Entry Air Data System (SEADS)	
170 38-53	WB1 70499	906 75-00	WB1-70599	506-63 32	WB1-70272
SOLAR SYSTEM		SPACE ERECTABLE STRUCTURES		Shuttle Infrared Leeside Temperature Sensing (SILTS)	
Planetary Materials Lunar Sample Analysis		Advanced Space Structures	WB1-70199	506-63 34	WB1 70273
152 01-40	WB1 70442	506 53-43	WB1-70199	Infrared Imagery of Shuttle	
Formation Evolution and Stability of Proto Stellar Disks		Large Space Structures Systems Technology	WB1-70264	506-63 35	WB1 70274
153 01-60	WB1 70446	506 62-43	WB1-70264	OEX Thermal Protection Experiments	
Planetary Dynamics		Large Space Structure System Engineering		506-63 36	WB1 70275
153 05-70	WB1 70450	906 55-00	WB1 70598	SPACE SHUTTLE PAYLOADS	
SOLAR TERRESTRIAL INTERACTIONS		SPACE EXPLORATION		Atmospheric Lidar System Definition	
Planetary Aeronomy Theory and Analysis		Space Engineering		146-60 03	WB1 70350
154 60-80	WB1 70467	506 53 10	WB1 70187	Phase B Studies - Landsat Solid State Sensor (LS3)	
Extended Atmospheres		Far Outer Planets Spacecraft Technology Definition		677-29 09	WB1 70417
154 80-80	WB1 70474	540 02 15	WB1 70282	Multispectral Linear Arrays for the Short-Wave Infrared (MLA/SWIR)	
SOLAR WIND		X Ray Gamma Ray and Neutron Gamma Ray Methods for Planetary Exploration		677-77 01	WB1-70438
Extended Atmospheres		157 03 50	WB1 70489	SPACE SHUTTLES	
154 80-80	WB1 70474	Ground Based Optical Planetary Astronomy		OEX Flight Data Analysis	
Mars Data Analysis - Astronomy		196 41 80	WB1 70529	506 51 31	WB1 70177
155 41-80	WB1 70482	Laboratory Supporting Studies (Astronomy)		Space Shuttle Aerodynamic Experiments	
Magnetospheric Physics Particles and Particle/Field Interaction		196-41-84	WB1 70531	506 51 34	WB1 70179
170-36-55	WB1 70491	Planetary Protection Program		Advanced Manned Vehicle Onboard Propulsion Technology	
Ground Based Observations of the Sun		199 50 94	WB1-70542	506-52 17	WB1 70181
170-38 52	WB1 70497	Fund for Independent Research		Thermal Protection Systems Materials and Systems Evaluation	
Origins of Plasma in the Earth's Neighborhood (OPEN)		506 56-19	WB1 70248	506 53 31	WB1-70195
171 03-00	WB1 70500	Cost Analysis of Space Flight Systems within the Office for Space and Terrestrial Applications		Thermal Protection Systems for Earth to Orbit STS	
Pioneer 6 11 Plasma Data Analysis		146 90-03	WB1 70351	506-53 33	WB1 70196
385 36 01	WB1 70556	Ground Based Radio and Radar Planetary Astronomy		Power Systems Management and Distribution	
SOLAR X-RAYS		196 41-85	WB1 70532	506 55 72	WB1-70240
X Ray Astronomy Time Variability and Polarimetry		SPACE MAINTENANCE		Space Shuttle Configuration and Aerothermodynamics	
188-46 59	WB1 70512	Satellite Services	WB1-70599	506-63 11	WB1 70268
Advanced Mission Study Solar X Ray Pinhole Satellite and Long Focal Length Coronagraph		906 75 00	WB1-70599	Space Shuttle Development Support	
356-38 01	WB1 70549	SPACE MISSIONS		506-63 13	WB1-70269
SOLID ROCKET PROPELLANTS		Space Mission Uplink Process Control Architecture		Shuttle Entry Air Data System (SEADS)	
High Energy Chemical Propulsion Technology for Planetary Spacecraft		540 01 15	WB1 70278	506-63 32	WB1-70272
506-52 25	WB1 70183	Space System Studies Information and Spacecraft Systems		Shuttle Upper Atmospheric Mass Spectrometer (SUMS)	
SOLID STATE		540 02 11	WB1 70280	506-63 37	WB1-70276
Solid State Research Superconducting Circuitry		Far Outer Planets Spacecraft Technology Definition		Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array	
506 54 69	WB1 70218	540 02 15	WB1 70282	542-03 04	WB1-70290
SOLID STATE DEVICES		Space Applications of Automation Robotics and Machine Intelligence Systems (ARAMIS)		30/20 GHz Spacecraft Multibeam Antenna Technology	
Aircraft Controls Electromechanical Actuator Technology		540 02 19	WB1 70283	650 60 20	WB1 70386
505 34-37	WB1 70053	JSC General Operations Support Planetary Materials		Shuttle Time and Frequency Transfer Experiment (STIFT)	
Electrophysics		152 05 40	WB1 70445	676-59 41	WB1 70409
506 54-42	WB1 70208	SPACE NAVIGATION		Particle and Particle Field Interactions	
Satellite Communications Technology		Advanced Spacecraft Pointing and Control Systems		170-36 55	WB1 70490
541 02 12	WB1 70287	506-54 93	WB1 70224	Development of Solar Spacelab Experiment and Hardware	
Multispectral Linear Arrays for the Short-Wave Infrared (MLA/SWIR)		Precision Pointing and Control Technology (PPACT) Development		170-38 51	WB1 70496
677 77-01	WB1 70438	506-54 59	WB1 70225	Particle Astrophysics and Shuttle Experiment Definition	
SOLIDIFIED GASES		High Speed Data Transfer X/S Band Components		188-46 56	WB1 70509
Sensor Cooling System		506 61 25	WB1 70251	Radiation Effects and Protection RTOP	
506 61-46	WB1 70259	Attitude/Orbit Systems Technology		199-20 70	WB1 70541
SONAR		310-10 26	WB1 70573	Development of Shuttle Infrared Telescope Facility (SIRTF)	
Systems for Underwater Survey and Exploration (SUSE)		Radio Metric Analysis Demonstration and Instrumentation Development		358 41 06	WB1 70551
637 01-02	WB1 70381	310 10 60	WB1 70575	SPACE STATIONS	
SONDES		SPACE POWER REACTORS		Large Space Structures Systems Technology	
Improved Measurement and Calibration Techniques for Stratospheric Trace Species		Thermal Management for On Orbit Energy Systems		506 62 43	WB1-70264
146 60-01	WB1 70348	506-62 67	WB1-70267	Earth Orbital Platform Systems Auxiliary Electric Propulsion for Spacecraft Systems	
SONIC BOOMS		SPACE PROBES		506 62 62	WB1-70266
SRC - Aerodynamic Performance Technology		Planetary Probe Aerothermodynamic Technology		Advanced Mission Study Solar X Ray Pinhole Satellite and Long Focal Length Coronagraph	
533 01 43	WB1 70147	506-51 21	WB1 70175	356 38 01	WB1-70549
SOUND WAVES		Planetary Probe Technology		Spacelab Science Payloads Definition ATD General	
Advanced Electronic Components		506-51 23	WB1 70176	356 78-01	WB1-70550
506-54-63	WB1 70216	Space System Studies Information and Spacecraft Systems		Spacelab Science Payload Definitions ATD General	
Development of a Shuttle Flight Experiment Drop Dynamics Module		540 02 11	WB1 70280	358-78 01	WB1-70552
542-03 01	WB1 70289	Far Outer Planets Spacecraft Technology Definition		SPACE TRANSPORTATION	
OUNDING		540 02 15	WB1 70282	Composites for Advanced Space Systems	
Global Weather Research		SPACE PROCESSING		506 53 23	WB1-70192
146 30 02	WB1 70330	Advanced Radiant Energy Conversion		Thermal Protection Systems Materials and Systems Evaluation	
OUNDING ROCKETS		506-55-13	WB1 70227	506 53-31	WB1 70195
Improved Measurement and Calibration Techniques for Stratospheric Trace Species		Advanced Energy Technology		Thermal Protection Systems for Earth-to-Orbit STS	
146-60-01	WB1 70348	506-55-15	WB1 70228	506 53 33	WB1 70196
Particle and Particle Field Interactions		Development of a Shuttle Flight Experiment Drop Dynamics Module		Shuttle Derived Vehicle Technology Requirements	
542-03 01	WB1 70289	542 03-01	WB1 70289	540 03 19	WB1-70285
OUNDING		Advanced Containerless Processing Technology		Space Systems and Planning Analysis	
Global Weather Research		179 20-55	WB1 70367	540 04 10	WB1 70286
146 30 02	WB1 70330	Electrostatic Control & Manipulation of Materials for Containerless Processing			
OUNDING ROCKETS		179 20-56	WB1 70368		
Improved Measurement and Calibration Techniques for Stratospheric Trace Species		Acoustic Containerless Experiment System (ACES)			
146-60-01	WB1 70348	179 70-10	WB1 70370		

Global Terrestrial Ecology	WB1 70546	Planetary Probe Aerothermodynamic Technology	Advanced Energy Technology
199 70-31		506-51 21	506-55 15
SPACE TRANSPORTATION SYSTEM		Planetary Probe Technology	WB1 70228
Thermal Control System Technology	WB1 70198	506-51 23	Ion Thruster Research and Ion Beam Applications
506 53-39		506-53-60	WB1 70231
Loads Dynamics and Aeroelasticity	WB1 70202	Interdisciplinary Research in Composite Structures	Planetary Power Systems R & T
506 53 63		505-33 60	506-55-75
Space Shuttle Configuration and		WB1 70042	W81 70241
Aerothermodynamics		SPACECRAFT CONSTRUCTION MATERIALS	SPACECRAFT PROPULSION
506 63 11	WB1-70268	Interdisciplinary Research in Composite Structures	Advanced Manned Vehicle Onboard Propulsion
Space Shuttle Development Support	WB1-70269	506-53-60	Technology
506 63 13	WB1-70272	199-50 94	506-52 17
ACIP - (Aerodynamic Coefficient Identification Package)	WB1-70270	WB1-70542	W81-70181
506 63 27	WB1-70274	Advanced Spacecraft Pointing and Control Systems	High Energy Chemical Propulsion Technology for
OEX (Orbiter Experiments) Project Support	WB1-70271	506-54 93	Planetary Spacecraft
506-63-31		Precision Pointing and Control Technology (PPACT)	506-52-25
Shuttle Entry Air Data System (SEADS)		Development	WB1-70183
506-63-32	WB1-70272	506-54 95	Advanced Chemical Propulsion Concepts For Planetary
Shuttle Infrared Leeside Temperature Sensing (SILTS)	WB1-70273	WB1 70225	506-52 35
506-63 34	WB1-70273	SPACECRAFT DESIGN	Electric Propulsion Technology
Infrared Imagery of Shuttle	WB1-70274	Integrated Programs for Aerospace-Vehicle Design	506-55-22
506 63-35	WB1-70274	(IPAD)	W81-70230
OEX Thermal Protection Experiments	WB1-70275	510-54-13	Thermal-Electric and Thermionic Energy Conversion
506 63-36	WB1-70275	Computational and Experimental Aerothermodynamics	Technology
Shuttle Upper Atmospheric Mass Spectrometer (SUMS)	WB1-70276	506-51-11	506 55-65
506 63-37	WB1-70276	Space Vehicle Aerothermodynamics and Configuration	WB1-70239
Technology Requirements of Future Integrated Space Transportation Systems	WB1-70275	Technology	Earth Orbital Platform Systems - Auxiliary Electric
540 03-13	WB1-70284	506-51 13	Propulsion for Spacecraft Systems
Long Duration Exposure Facility	WB1-70296	Planetary Probe Aerothermodynamic Technology	506 62-62
542 04-13	WB1-70296	506 51 21	Space Propulsion and Power System Studies
SPACE TRANSPORTATION SYSTEM FLIGHTS		Planetary Probe Technology	540 02-12
OEX Thermal Protection Experiments	WB1-70275	506 51 23	WB1-70281
506 63-36	WB1-70275	OEX Flight Data Analysis	542 05-12
SPACEBORNE ASTRONOMY		506 51 31	WB1-70297
Infrared Detectors Far IR Sensors	WB1-70253	Space Shuttle Configuration and	SPACECRAFT REENTRY
506-61-31		Aerothermodynamics	Shuttle Entry Air Data System (SEADS)
Remote Sensing Systems	WB1-70255	506-63-11	506-63-32
506-61 35	WB1-70255	Space Shuttle Development Support	Shuttle Upper Atmospheric Mass Spectrometer
SPACEBORNE EXPERIMENTS		506 63 13	506-63-37
Utilization of Space for Science Experiments	WB1-70249	WB1-70269	SPACECRAFT STRUCTURES
506-56-29	WB1-70249	506-63 31	Thermal Control System Technology
Instrument Pointing Systems	WB1-70258	WB1 70271	506 53 39
506 61 43	WB1-70258	Far Outer Planets Spacecraft Technology Definition	WB1 70198
OEX (Orbiter Experiments) Project Support	WB1-70271	540 02-15	SPACECRAFT TRACKING
506 63-31	WB1-70271	Communications Satellite Applications Systems	High Speed Data Transfer X/S Band Components
Development of a Shuttle Flight Experiment Drop Dynamics Module	WB1-70289	643-10-02	506 61-25
542-03-01	WB1-70289	Origins of Plasma in the Earth's Neighborhood (OPEN)	Precision Time and Frequency Sources
Spacelab 2 Superfluid Helium Experiment	WB1-70291	171 03 00	310 10-42
542-03-13	WB1-70291	Radiation Effects and Protection RTOP	Radio Metric Analysis Demonstration and
Tribological Experiments in Zero Gravity	WB1-70293	199 20 70	Instrumentation Development
542-03 27	WB1-70293	Satellite Services	310-10-60
Cryogenic Fluid Management	WB1-70295	906 75 00	VLBI Development and Analysis
542-03 52	WB1-70295	WB1 70599	310-10-61
Long Duration Exposure Facility	WB1-70296	SPACECRAFT ENVIRONMENTS	Navigation Technology Development
542-04 13	WB1-70296	Thermal Control System Technology	310-10-63
Environmental Monitoring Research Satellite Mission Studies	WB1-70349	506 53 39	Technology for TDRSS User Spacecraft
146-60-02	WB1-70349	Planetary Power Systems R & T	310 20 46
Shuttle Time and Frequency Transfer Experiment (STIFT)	WB1-70349	506 55 75	Systems Management Technology
676 59-41	WB1 70409	Systems Habitability Verification	310 40 49
Sounding Rocket Experiments (High Energy Astrophysics)	WB1 70570	199-10 41	SPACECRAFT INSTRUMENTS
879-11 46	WB1 70570	WB1 70537	Planetary & Solar Spacecraft Systems Automated Optical Navigation
SPACEBORNE PHOTOGRAPHY		SPACECRAFT GUIDANCE	506 62-55
Data Reproduction in Support of the Mars Data Analysis Program	WB1 70484	Advanced Spacecraft Pointing and Control Systems	WB1-70265
155-50 01	WB1 70484	506 54-93	SPACECRAFT CREWS
SPACEBORNE TELESCOPES		WB1 70224	Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection)
Multi-Spectral Detectors and Sensors	WB1 70211	506 54 95	199-10-20
506-54 46	WB1 70211	WB1 70225	WB1-70535
SPACECRAFT		WB1 70225	Crew Health Maintenance
Space Vehicle Dynamics Methodology	WB1 70204	506 56 19	199-10-30
506 53-65	WB1 70204	WB1 70248	Man Machine Engineering Requirements for Data and Functional Interfaces
SPACECRAFT CHARGING		506-63 34	199-60-71
Planetary Power Systems R & T	WB1 70241	Infrared Imagery of Shuttle	WB1 70544
506-55 75	WB1 70241	WB1-70274	SPACELAB
SPACECRAFT COMMUNICATION		WB1 70241	Development of a Shuttle Flight Experiment Drop Dynamics Module
Automation of Space Mission Uplink Process Control	WB1-70220	506-63-37	542-03 01
506-54 75	WB1-70220	WB1 70276	WB1 70289
High Speed Data Transfer X/S Band Components	WB1 70221	Superconducting Gravity Gradiometer	542-03 13
506 61 25	WB1 70251	676-59 33	WB1 70291
High Speed Data Transfer S/K-Band Components and Techniques	WB1-70220	Instrument Development for Spaceflight Experiments	542-03 20
506-61-26	WB1-70220	157 03 40	Tribological Experiments in Zero Gravity
Space Mission Uplink Process Control Architecture	WB1-70220	WB1 70488	542-03 27
540-01-15	WB1-70278	Spacelab Science Payloads Definition ATD - General	Semiconductor Materials Growth in Low g Environment
Satellite Communications Technology	WB1-70287	356-78 01	542-03-30
541-02 12	WB1-70287	WB1 70550	Cryogenic Fluid Management
Systems Coordination Support	WB1-70379	685-20 11	542-03-52
643 10 03	WB1-70379	WB1-70567	WB1-70295
Commercial Fisheries Ocean Forecast Demonstration	WB1-70401	SPACECRAFT MANEUVERS	Environmental Monitoring Research Satellite Mission Studies
663 90-03	WB1-70401	Advanced Spacecraft Pointing and Control Systems	146-60 02
Network Productivity Research	WB1-70596	506-54 93	WB1-70349
310-40-73	WB1-70596	WB1-70224	Development of Solar Spacelab Experiment and Hardware
SPACECRAFT CONFIGURATIONS		SPACECRAFT MOTION	170-38 51
Computational and Experimental Aerothermodynamics	WB1 70173	Precision Pointing and Control Technology (PPACT)	WB1 70496
506-51 11	WB1 70173	Development	356-78 01
Space Vehicle Aerothermodynamics and Configuration Technology	WB1-70174	506 54 95	WB1 70550
506 51 13	WB1-70174	WB1-70225	Development of Shuttle Infrared Telescope Facility (SIRTF)
		SPACECRAFT ORBITS	358-41 06
		Electric Propulsion Technology	WB1 70551
		506-55 22	SPACELAB PAYLOADS
		WB1 70230	Spacelab 2 Superfluid Helium Experiment
		Planetary & Solar Spacecraft Systems Automated Optical Navigation	542-03 13
		506-62 55	WB1 70291
		WB1 70265	SPARK CHAMBERS
		SPACECRAFT PERFORMANCE	Gamma Ray Astronomy
		Space Shuttle Aerodynamic Experiments	188-46-57
		506-51-34	WB1 70510
		WB1-70179	SPARK IGNITION
		Advanced Energetics	Advanced General Aviation Propulsion Research
		506-55 12	505 41 22
		WB1-70226	WB1 70073
		Advanced Radiant Energy Conversion	
		506-55 13	

SPECIFIC IMPULSE		SPILLING		In Situ Measurements of Stratospheric Ozone and Total Chlorine
Advanced Chemical Propulsion Concepts For Planetary Spacecraft	W81 70185	Post Spill Liquid Hydrogen Behavior	505 31 70	147 10 01 W81-70353
506 52-35				Stratospheric Research Field Measurements Program
SPECIFICATIONS		SPRAYERS		147 10-02 W81-70354
Systems Habitability Verification	W81 70537	Aerial Applications Aerodynamics and Systems Interaction	505 41 83	Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere
199 10 41				147 10-02 W81-70355
SPECTRAL BANDS		SPRAYING		Atmospheric Processes Experiments and Systems
High Spectral Resolution Remote Sensing	W81 70420	Aerial Applications Aerodynamics and Systems Interaction	505 41 83	147 10-03 W81-70356
677 41 08				Upper Atmosphere Research Laboratory
Geobotanical Test Site Investigations	W81 70424			Measurements
677 42 01		SPREADING		147 20-01 W81 70357
SPECTRAL CORRELATION		Tribological Experiments in Zero Gravity	542 03 27	Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere
X Ray Astronomy Data Analysis	W81 70564			147 20-03 W81-70359
389 46 04		SQUID (DETECTORS)		Stratospheric Theoretical Studies and Science Definition Activities
SPECTRAL REFLECTANCE		Solid State Research Superconducting Circuitry	506 54 69	147 30 01 W81-70361
Earth Based Solar System Observations	W81 70528			Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere
196 41 78		STABILIZATION		147-30 01 W81 70362
SPECTRAL RESOLUTION		Instrument Pointing Systems	506-61 43	Stratospheric Research
Surface Mine Rehabilitation Inventory and Monitoring	W81 70411			147 30 02 W81 70363
677 21 20		STANDARDIZATION		Stratospheric Modeling
High Spectral Resolution Remote Sensing	W81 70420	OSTA Data Systems Standards and Guidelines	656 13 10	147 30 02 W81-70364
677 41-08				Laser Heterodyne Spectrometer (LHS) Brassboard
Remote Sensing	W81 70452	STANDARDS		147 40 01 W81 70366
153 07 40		Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection)	199 10 20	Mars Data Analysis
SPECTROMETERS				155-04 80 W81-70478
Multi Spectral Detectors and Sensors	W81 70211	STARS		STRESS ANALYSIS
506-54-46		Data Analysis Astronomy	389 41 01	Failure and Thermal Analysis
Signal Detection and Processing	Filters and Receivers			506-53 53 W81 70200
506 54-56	W81 70213	Sounding Rockets Experiments (Astronomy)	879 11 41	STRESS CONCENTRATION
Sensor Systems Technology				Regional Crustal Deformation Modeling
506-61-33	W81 70254	STATIONKEEPING		676-10 10 W81 70402
Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere		Electric Propulsion Technology	506 55 22	STRESS-STRAIN RELATIONSHIPS
147-10-02	W81 70355			High Temperature Structures
Radar Spectrometer		STATISTICAL ANALYSIS		505-33 72 W81 70045
677-27 04	W81 70414	Planetary Atmospheres Data Analysis	155 04 80	Interdisciplinary Research in Composite Structures
Aircraft Thermal Infrared Scanner				505-33-60 W81 70042
677 47 01	W81 70432	Data Reproduction in Support of the Mars Data Analysis Program		Aeronautical Structural Design Methods
Atmospheric Experiment Development				505-33 63 W81 70044
154-90 80	W81 70476	155 50 01		505-33 72 W81 70045
Gamma Ray Astronomy		W81 70484		Advanced Space Structures
188-46-57	W81 70510	Experiment Development Laboratory and Theoretical Solar Physics		506-53 43 W81 70199
Astronomical Optical Instrument Development		170 38 53		Failure and Thermal Analysis
196-41-81	W81 70530	W81 70499		506-53 53 W81 70200
X Ray Astronomy Data Analysis		Particle Astrophysics	188 46 56	Optimization of Structural Systems
389-46 04	W81 70564	Magnetospheric Data Analysis	385 36 01	506-53 55 W81 70201
SPECTROPHOTOMETERS				STRUCTURAL DESIGN
Improved Measurement and Calibration Techniques for Stratospheric Trace Species		STELLAR ATMOSPHERES		Loads Dynamics and Aeroelasticity
146-60-01	W81 70348	UV and Optical Astronomy	188 41 51	505-33 52 W81 70039
SPECTROPHOTOMETRY		Ground Based Infrared Astronomy	196 41 50	Interdisciplinary Research in Composite Structures
UV and Optical Astronomy	W81 70501	Data Analysis Astronomy	389 41-01	505-33-60 W81 70042
188-41 51				Integrated Analysis and Synthesis
Optical Astronomy		STELLAR EVOLUTION		505-33-62 W81 70043
196-41 71	W81 70525	Infrared and Radio Astronomy	188-41-55	General Aviation Crash Dynamics
Data Analysis Astronomy		Theoretical Infrared and Radio Astrophysics	188 41-55	505 41 33 W81 70074
389 41 01	W81-70561			SCR Materials and Structures
SPECTRORADIOMETERS		STEREOSCOPIC VISION		533 01 13 W81 70144
High Spectral Resolution Remote Sensing		Robotics/Machine Intelligence Automated Systems	506-54-85	SCR Materials and Structures Flight Research
677 41 08	W81 70420			533 01-14 W81 70145
Geological Mapping Kilauea Caldera Stratigraphy		STIRLING CYCLE		Failure and Thermal Analysis
677 41 09	W81 70421	Stirling Engine Components and System Concepts	778 46-22	506 53 53 W81 70200
SPECTROSCOPY		Validation of Stirling Lab Engine	778 46 35	Optimization of Structural Systems
Fund for Independent Research				506 53-55 W81 70201
506 56 16	W81 70247	STORMS		Loads Dynamics and Aeroelasticity
Sensor Systems Technology		Aviation Meteorology Research Severe Storms	505 44 13	506 53 56 W81 70203
506 61 33	W81 70254	Severe Storms and Local Weather Research	542 05 12	STRUCTURAL DESIGN CRITERIA
Remote Sensing Systems		146 50 02		Aeroelasticity of Turbine Engines
506 61-35	W81-70255	Severe Storms and Local Weather Research	146 50 02	510 55 12 W81 70119
Global Weather Research		STORMS (METEOROLOGY)		Flight Test of an Ion Auxiliary Propulsion System (IAPS)
146 30-02	W81 70330	Aviation Meteorology Research Atmospheric Dynamics & Measurement Tech	505 44 18	542 05 12 W81 70297
Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere				STRUCTURAL ENGINEERING
147 20-03	W81 70359	505 44 18		Space Engineering
Geological Mapping Kilauea Caldera Stratigraphy		STRAIN RATE		506-53-10 W81 70187
677 41-09	W81 70421	Advanced Geodynamics Studies	676 59 30	STRUCTURAL PROPERTIES (GEOLOGY)
Radiative Transfer in Cloudy Atmosphere				Terrain Models for SAR Development
154 40-80	W81 70464	STRATIFICATION		677-43-01 W81 70425
Atomic and Molecular Properties		Alaska Wetlands Delineation Program	677 21 22	Tectonic Structure in Pakistan
154-50-80	W81 70466			677 43 03 W81 70426
UV and Optical Astronomy		STRATIGRAPHY		Integrated Study of Continental Rift Systems
188 41-51	W81 70502	Geological Mapping Kilauea Caldera Stratigraphy	677-41 09	677 43 05 W81 70427
Radio Astronomy				Pipeline/Nuclear Plant Engineering Geology
188-41-55	W81 70507			677 44 01 W81 70428
Cometary Observation and Theory		STRATOSPHERE		Crustal Modeling Using Satellite Potential Field Data
196 41-30	W81 70518	Photophysics and Laser Diagnostics	506-54 41	677 45-01 W81 70429
SPECTRUM ANALYSIS		Ozone Data Reduction and Analysis and Solar UV	146-60-01	Theoretical Studies of Planetary Bodies
Technical Consultation Services		Varability	146-60-01	151 02 60 W81 70441
643 10-01	W81-70376			Experimental Studies
Dynamics of Planetary Atmospheres		STRUCTURAL RELIABILITY		153 02 40 W81 70447
154-20-80	W81-70460			Composite Components Technology
Cometary Observation and Theory		STRUCTURAL STABILITY		534 03 13 W81 70162
196-41-30	W81-70518	Stratospheric Measurement Program Activities	146-60 01	Advanced Turboprop Program
Theoretical Planetary Astronomy		Improved Measurement and Calibration Techniques for Stratospheric Trace Species	146-60-01	535-03 12 W81 70169
196 41-85	W81-70533	Upper Atmosphere Research Field Measurements	147-10 01	Large Composite Primary Aircraft Structures (LCPAS) - Key Technology
SPEECH RECOGNITION				534 03-33 W81 70163
Man Machine Systems				
199-60-60	W81-70543			
SPHEROIDS				
Development of a Shuttle Flight Experiment Drop Dynamics Module				
542 03-01	W81-70289			
Fusion Target Technology Study				
179-20-57	W81-70369			

SUBJECT INDEX

Space Vehicle Dynamics Methodology	W81-70204
508-53-65	
Ocean Thermal Energy Conversion	Study and
Assessment	
776-91-40	W81-70302
STRUCTURAL VIBRATION	
Rotocraft Aeroelasticity and Structural Dynamics	
505-42-11	W81-70081
Rotocraft Structures Vibration Aeroelasticity and	
Acoustics	
505 42 13	W81 70082
Rotocraft Aerodynamic Performance Dynamics and	
Handling Qualities	
505 42 21	W81 70083
SUBMILLIMETER WAVES	
Quantum Electronics Sources	
506-54-45	W81 70210
Remote Sensing Systems	
506 61 35	W81 70255
Sensor Systems	
506-61 36	W81 70256
Atomic and Molecular Properties	
154 50-80	W81 70466
Study of Large Deployable Antennas for Astronomy	
Applications	
358 78 60	W81 70553
SUBSONIC FLOW	
Airfoil Development	
505 31-33	W81-70006
Aerodynamic Theory/Experimental Integration	
505 31 41	W81 70007
SUBSTRATES	
Surface Physics and Computational Chemistry	
506-53-11	W81-70188
SULFIDES	
NASA/Geosat Test Case Study	
677 41-02	W81-70418
SULFUR	
Planetary Clouds Particulates and Ices Clouds of	
Venus	
154 30-80	W81-70462
Aeronomy Chemistry	
154 75 80	W81-70473
SULFUR OXIDES	
Aeronomy of Planetary Atmospheres Chemistry	
154 75-80	W81 70472
SUPERCONDUCTIVITY	
Solid State Research Superconducting Circuitry	
506 54 69	W81 70218
Funds for Independent Research (Space)	
506-56-11	W81 70244
Fund for Independent Research (Space)	
506 56 12	W81 70245
Superconducting Gravity Gradiometer	
676 59 33	W81 70406
SUPERCONDUCTORS	
Signal Detection and Processing Filters and Receivers	
506 54 56	W81 70213
Solid State Research Superconducting Circuitry	
506 54-69	W81 70218
SUPERCRITICAL WINGS	
Configuration Aerodynamics	
505 31 43	W81 70008
SUPERFLUIDITY	
Spacelab 2 Superfluid Helium Experiment	
542 03-13	W81 70291
SUPERHIGH FREQUENCIES	
Analysis of Multifrequency/Multipolarization SAR	
Imagery	
677 41-12	W81 70423
Radio Metric Analysis Demonstration and	
Instrumentation Development	
310 10-60	W81-70575
X Band Uplink Development	
310 20 64	W81 70583
Antenna Systems Development	
310 20-65	W81-70584
Radio Systems Development	
310 20-66	W81 70585
RFI Systems Technology	
310 30 69	W81-70588
SUPERPLASTICITY	
SCM Materials and Structures	
533 01 13	W81 70144
SUPERPOSITION (MATHEMATICS)	
Fatigue Damage and Environmental Effects in Metals	
and Composites	
505-33-21	W81 70033
SUPersonic AIRCRAFT	
Basic Noise Research	
50E 32 05	W81-70019
Human Factors Flight Research with High Performance	
Aircraft and RPVs	
505-35-24	W81 70058
Fuel Tank Sealants	
533 01 11	W81-70143
High Performance Aircraft Flight Test Support	
533-02 24	W81 70151
Integrated Research Aircraft Control Technology	
533 02 44	W81 70153
Variable Cycle Engine Technology	
535 02 12	W81 70168
SUPersonic AIRFOILS	
Airfoil Development	
505 31-33	W81 70006

SUPersonic COMBUSTION	
High Temperature Aeronautical Structures	
505-33-73	W81 70046
SUPersonic CRUISE AIRCRAFT RESEARCH	
Configuration Aerodynamics	
505 31-43	W81 70008
SCR Materials and Structures	
533-01-13	W81 70144
SCR Materials and Structures Flight Research	
533-01-14	W81-70145
SCR Propulsion Technology	
533-01-32	W81 70146
SRC Aerodynamic Performance Technology	
533-01-43	W81-70147
Propulsion System/Airframe Integration Technology	
533-01-62	W81 70148
SCR Airframe/Propulsion System Interactions	
533-01-63	W81-70149
SUPersonic FLOW	
Aerodynamic Theory/Experimental Integration	
505-31 41	W81-70007
Hypersonic Propulsion Research	
505-32 93	W81-70030
SUPPORT SYSTEMS	
JSC General Operations Support	
152-05 40	Planetary Materials
JSC General Operations	W81-70445
Geochemistry	Geophysics and
153 10 40	W81-70456
SURFACE GEOMETRY	
Ocean Circulation and Topography	
146 40-07	W81 70337
SURFACE PROPERTIES	
Surface Physics and Computational Chemistry	
506-53 11	W81 70188
Planetary Synthesis	
153 06-70	W81 70451
SURFACE REACTIONS	
Post Spill Liquid Hydrogen Behavior	
505-31 70	W81 70014
OEX Flight Data Analysis	
506 51 31	W81 70177
SURFACE ROUGHNESS	
Extended Scene Radar Calibration	
677 47-02	W81 70433
SURFACE TEMPERATURE	
Propulsion Instrumentation Research	
505 32-82	W81 70028
SURFACE VEHICLES	
Aerodynamics of Ground Vehicles	
141 20 11	W81-70316
SURFACES	
Aeronautics Flight Experiments	
505-31-44	W81-70009
SURVEILLANCE	
RFI Systems Technology	
310 30-69	W81 70588
SWITCHES	
Aircraft Controls Electromechanical Actuator	
Technology	
505-34 37	W81-70053
Network Systems Technology Development	
310-20 33	W81-70580
SWITCHING	
Satellite Switching and Processing Systems	
650-60 21	W81-70387
SYNCHRONISM	
Shuttle Time and Frequency Transfer Experiment	
(STIFT)	
676-59 41	W81-70409
Network Timing and Synchronization Technology	
310 20 27	W81 70579
SYNTHETIC APERTURE RADAR	
Advanced Synthetic Aperture Radar Technology	
506 61 37	W81-70257
Ocean Wave Height Determination with the Synthetic	
Aperture Radar	
146 40 40	W81 70334
Synthetic Aperture Radar Processor	
656 62 01	W81 70400
Integration of VIS IR-NW Data	
677 21 06	W81 70410
Rock Type/Microwave Techniques (Imaging Radar	
Geology)	
677 41 04	W81 70419
Analysis of Multifrequency/Multipolarization SAR	
Imagery	
677 41 12	W81 70423
Terrain Models for SAR Development	
677 43-01	W81 70425
NASA Airborne Imaging Radar Facility	
677-47-03	W81 70434
Seasat Digital SAR Processing (Non-Renewable	
Resources)	
677 48-01	W81 70435
Seasat Digital SAR Processing (Renewable Resources)	
677-76-01	W81 70436
High Speed Signal Processing Research	
310-30 70	W81-70589
SYNTHETIC FUELS	
Fuels Research	
505-32-72	W81-70027
Broad Property Fuels Technology	
511-59 12	W81-70123
SYSTEMS ENGINEERING	
Advanced Energy Technology for Utilities	
778-50-29	W81 70315
SYSTEMS ANALYSIS	
Integrated Analysis and Synthesis	
505 33 62	W81-70043
Advanced Power System Technology	
506 55-76	W81-70242
Space Mission Uplink Process Control Architecture	
540 01 15	W81 70278
Technology Requirements of Future Integrated Space	
Transportation Systems	
540-03-13	W81-70284
Communications Satellite Applications Systems	
643-10-02	W81 70378
Demonstration Flight System and Operational Land	
Observing System (OLOS)	
677-29-06	W81-70416

Arrayed Network Technology	W81-70597	TECTONICS	Regional Crustal Deformation Modeling	W81 70402	TEXTURES	Experimental Studies
310 40 74 Large Space Structure System Engineering	W81-70598	676 10 10	Global Earth Dynamics and Structure	W81-70403	153 02 40	W81 70447
906 55-00 Satellite Services	W81-70599	676-30 01	Tectonic Structure in Pakistan	W81 70426	THEMATIC MAPPING	Surface Mine Rehabilitation Inventory and Monitoring
906-75-00		677 43-03	Crustal Modeling Using Satellite Potential Field Data	W81 70429	677 21 20	Very Low Cost Data System 16-Bit
SYSTEMS MANAGEMENT		677 45 01	W81-70594	677 76-04	Microprocessor Driven ELAS	W81-70437
Software Engineering Technology		TELECOMMUNICATION	Satellite Communications Technology	W81 70287	THERMAL EMISSION	Planetary Atmospheres Composition and Structure
310 10-23	W81-70572	541 02-12	Communication Satellite Application Systems	W81 70377	154-10 80	W81 70458
Systems Management Technology		643-10 02	Systems Coordination Support	W81 70379	Clouds Particulates and Ices	
310-40-49	W81-70594	643 10 03	Remote Sensing Frequency Coordination Studies	W81 70380	154 30 80	W81 70463
		643-10-04	W81-70594	196 41-40	Remote Sensing Of Planetary Surfaces	W81 70519
T					THERMAL ENERGY	Waste Heat Automotive Air Conditioner
T-37 AIRCRAFT					778-48-17	W81 70312
Interagency Assistance and Testing					TERMAL ENVIRONMENTS	Interior Models
505 43 34	W81 70098				153 03 42	W81 70449
Aircraft Operational Support					TERMAL FATIGUE	Liquid-Chemical Propulsion Technology
505-43-54	W81 70100	506-61-26	NASA End to End Data System	W81 70252	506 52-12	W81 70180
T-38 AIRCRAFT		506 61-55	W81-70261	506 53 12	Materials Science	W81 70189
Aircraft Operational Support		540 01-16	Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame	W81 70279	506 62-67	W81 70267
505 43 54	W81 70100	879-11 46	Sounding Rocket Experiments (High Energy Astrophysics)	W81 70570	TERMAL INSULATION	Thermal Management for On Orbit Energy Systems
TAKEOFF		X Band Uplink Development	W81 70583	506 53 31	W81 70195	
Terminal Configured Vehicle Program		310 20 64	Telemetry Technology Development	W81 70586	506-53 33	W81 70196
534-04-13	W81 70164	310-20 67	W81-70586	506 62 67	Thermal Management for On Orbit Energy Systems	
TAPE RECORDERS		199 60 80	W81 70545	506 63 34	Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81 70273
Technology for TDRSS User Spacecraft		643 10 01	W81-70375	506-63 36	OEX Thermal Protection Experiments	
310-20 46	W81 70582	179 80 10	W81 70372	505-33-31	W81 70275	
TDR SATELLITES		TEMPERATURE	W81-70449	505-33-31	Thermal Protection Systems Materials and Systems Evaluation	
Attitude/Orbit Systems Technology		Interior Models	W81 70449	506 53 31	Thermal Protection Systems for Earth to Orbit STS	W81 70195
310-10-26	W81 70573	153 03 42	W81-70449	506-53 33	Thermal Management for On Orbit Energy Systems	W81 70196
Network Timing and Synchronization Technology		TELEOPERATORS	W81 70583	506 62 67	Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81-70267
310 20 27	W81 70579	Advanced Teleoperation Studies	W81 70586	506 63 34	OEX Thermal Protection Experiments	W81 70273
Network Systems Technology Development		199 60 80	W81 70545	506-63-36	W81 70275	
310-20-33	W81 70580	W81-70375	W81 70372	505-33-31	Thermal Stabilty	Fire Resistant Materials
Technology for TDRSS User Spacecraft		TELEVISION TRANSMISSION	W81 70449	505-33-31	High Temperature Structures	
310 20 46	W81-70582	Technical Consultation Services	W81 70449	505-33-72	W81 70045	
Operations Support Computing Technology		643 10 01	W81 70375	TERMAL STRESSES	Thermal Protection Systems Materials and Systems Evaluation	
310 40 26	W81 70590	179 80 10	W81 70372	505-33-31	High Temperature Structures	
Human To Machine Interface Technology		TEMPERATURE	W81-70449	505-33-72	Thermal Protection Systems for Earth to Orbit STS	W81 70195
310-40-37	W81 70591	Interior Models	W81 70449	506 53 33	Thermal Management for On Orbit Energy Systems	W81 70196
Systems Management Technology		153 03 42	W81 70449	506 62 67	Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81-70267
310 40 49	W81-70594	TELLURIUM	W81 70449	506 63 34	OEX Thermal Protection Experiments	W81 70273
TECHNOLOGY ASSESSMENT		Infrared Detector Materials Preparation	W81 70259	506-63-36	W81 70275	
30/20 GHz Wideband System Definition		179 80 10	W81 70259	505-33-31	Thermal Stabilty	Fire Resistant Materials
650 20 16	W81 70384	TEMPERATURE	W81 70259	505-33-31	High Temperature Structures	
Satellite Communications Technology		Interior Models	W81 70259	505-33-72	W81 70045	
310 20-38	W81-70581	153 03 42	W81 70259	TERMAL STRESSES	Thermal Protection Systems Materials and Systems Evaluation	
Network Productivity Research		TEMPERATURE CONTROL	W81 70046	505-33-31	High Temperature Structures	
310 40 73	W81 70596	High Temperature Aeronautical Structures	W81 70046	505-33-72	Thermal Protection Systems for Earth to Orbit STS	W81 70195
TECHNOLOGY TRANSFER		Thermal Control System Technology	W81 70198	506 53 33	Thermal Management for On Orbit Energy Systems	W81 70196
Commercial Prototype Fusion Welding System (Computer Controlled/Closed Circuit Television Arc Guidance)		Sensor Cooling System	W81 70259	506 62 67	Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81-70267
141 95 01	W81 70318	506 61 46	W81 70259	506 63 34	OEX Thermal Protection Experiments	W81 70273
Prosthetic Urinary Sphincter Control Valving System		TEMPERATURE GRADIENTS	W81 70259	506-63-36	W81 70275	
141 95 02	W81 70320	Knowledge of High Altitude Atmospheric Processes	W81 70103	505-33-31	Thermal Stabilty	Fire Resistant Materials
Ocular Screening System		505 44 14	W81 70103	505-33-31	High Temperature Structures	
141-95-02	W81-70321	TEMPERATURE INVERSIONS	W81 70104	505-33-72	W81 70045	
Systems for Underwater Survey and Exploration (SUSE)		Microwave Technology Development for Atmospheric Turbulence Studies	W81 70104	506 53 29	TERMAL STRESSES	Thermal Protection Systems Materials and Systems Evaluation
637 01 02	W81 70381	505 44 15	W81 70104	506 53 29	High Temperature Structures	
Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)		TEMPERATURE MEASUREMENT	W81 70115	542 03 13	Spacelab 2 Superfluid Helium Experiment	W81 70291
637-01-03	W81 70382	Commercial Aircraft Fuel Savings	W81 70115	Stratospheric Research	Stratospheric Research	
Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment: HEBBLE)		Advanced Ocean Sensor Systems Development	W81 70340	147 30 02	W81 70363	
637 01 04	W81 70383	146 40 13	W81 70340	TERMODYNAMIC CYCLES	OEX Flight Data Analysis	
Commercial Fisheries Ocean Forecast Demonstration		TEMPERATURE PROFILES	W81 70476	506 51 31	SCR Propulsion Technology	
663 90 03	W81 70401	Atmospheric Experiment Development	W81 70476	533 01-32	W81 70146	
Crustal Modeling Using Satellite Potential Field Data		154 90-80	W81 70476	TERMODYNAMIC PROPERTIES	Long Term Space Environmental Effects on Materials	
677-45-01	W81 70429	TEMPERATURE SENSORS	W81 70476	506 53 29	W81 70194	
TECHNOLOGY UTILIZATION		Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81 70273	542 03 13	Spacelab 2 Superfluid Helium Experiment	W81 70291
Fund for Independent Research (Space)		Infrared Imagery of Shuttle	W81 70274	Stratospheric Research	Stratospheric Research	
506 56 13	W81 70246	506 63-35	W81 70274	147 30 02	W81 70363	
Fund for Independent Research		Improved Measurement and Calibration Techniques for Stratospheric Trace Species	W81 70274	TERMODYNAMIC CYCLES	OEX Flight Data Analysis	
506 56-19	W81 70248	146 60-01	W81 70274	506 51 31	SCR Propulsion Technology	
Integrated Modular Solar Energy Systems (Small Dispersed Solar Energy Systems Applications)		W81 70348	W81 70274	533 01-32	W81 70146	
776 91 19	W81 70300	Atmospheric Experiment Development	W81 70476	TERMODYNAMIC PROPERTIES	Long Term Space Environmental Effects on Materials	
OSTA Data Systems Standards and Guidelines		154 90-80	W81 70476	506 53 29	W81 70194	
656 13-10	W81 70390	TERRESTRIAL PLANETS	W81 70425	542 03 13	Spacelab 2 Superfluid Helium Experiment	W81 70291
OSTA/ADS Data Systems Standards and Guidelines Program		Petrology Lab	W81 70425	Stratospheric Research	Stratospheric Research	
656 13 10	W81 70391	153-02-70	W81-70448	147 30 02	W81 70363	
Full Scale Applications Data Service (ADS) Planning Studies		TEST EQUIPMENT	W81 70448	TERMOELECTRIC MATERIALS	OEX Flight Data Analysis	
656 13 20	W81 70392	Turbine Engine Hot Section Technology (HOST)	W81 70098	506 51 31	Thermal-Electric and Thermionic Energy Conversion Technology	
Applications Data Service (ADS) Atmospheric Pilot System		510 55-12	W81 70120	506-55-65	W81 70239	
656 13 30	W81-70393	Orbital Energy Storage and Power Systems (H2/O2)	W81 70238	506-55-65	Thermal-Electric and Thermionic Energy Conversion Technology	
ADS Oceanic Pilot System Project		506-55-57	W81 70238	506-55-65	W81 70239	
656 13 40	W81 70394	TEST FACILITIES	W81-70448	506-55-65	Thermal-Electric and Thermionic Energy Conversion Technology	
Oceanic Data Utilization System Study		Interagency Assistance and Testing	W81 70098	506-55-65	W81 70239	
656 13 60	W81-70395	505 43 34	W81 70098	506-54-69	Thin Films	Thermal-Electric and Thermionic Energy Conversion Technology
ADS Pilot Geosciences Information Network Development		Advanced Guidance and Control Experiments	W81 70098	506-54-69	Solid State Research Superconducting Circuity	
656 13 70	W81 70396	512-54 14	W81 70125	506-54-69	W81 70218	
Applications Data Base Management System (ADBMS)		Wallop Flight Center Research Airport Support	W81 70125	506-54-69	Solar Cell Technology	
656 31-02	W81 70397	534 04 18	W81-70165	506-54-69	W81 70233	
Registration of Radar and Other Data		Station Monitor and Control Technology	W81 70165	506-54-69	Spacelab 2 Superfluid Helium Experiment	
656-45-02	W81 70399	310-30 68	W81 70587	542-03-13	W81-70291	
TEXAS		TEST EQUIPMENT	W81 70587	THREE DIMENSIONAL FLOW	Airfoil and Wing Development	
		Crustal Modeling Using Satellite Potential Field Data	W81 70429	505-31 31	Numerical Aerodynamic Simulator (NAS Project)	
		677-45 01	W81 70429	536-01 11	536-01 11	
					THRUST	V/STOL Propulsion Research
					505 42 62	W81-70087
					THRUST AUGMENTATION	Combustion and Emissions Reduction Research
					505-32 32	W81-70023

THRUST CONTROL		TRAJECTORY OPTIMIZATION		TRAVELING WAVE MASERS
V/STOL Propulsion Research	W81 70087	Planetary & Solar Spacecraft Systems Automated Optical Navigation	W81 70265	Station Monitor and Control Technology
505 42 62		506-62 55		310 30-68
V/STOL Propulsion System Technology	W81 70140	506-54-59		W81 70587
532 05 12		506-61-26		Electrophysics
Earth Orbital Platform Systems - Auxiliary Electric Propulsion for Spacecraft Systems		506-61-26		506-54 42
506 62 62	W81-70266			High Efficiency Technology for Microwave Amplifiers
THRUST REVERSAL				506-61 22
Combat Veh & Missile Aerodyn & Flight Dyn R & T				Radar Spectrometer
505 43 22	W81 70094			677-27 04
THRUST VECTOR CONTROL				W81-70414
Combat Veh & Missile Aerodyn & Flight Dyn R & T				TRIBOLOGY
505 43 22	W81 70094			Tribological Experiments in Zero Gravity
TIILT ROTOR AIRCRAFT				542-03 27
Tilt Rotor Research Aircraft Flight Investigations				W81 70293
532 04 11	W81 70137			TROJAN ORBITS
Flight Test of the Tilt Rotor Research Aircraft				Planetary Dynamics
532 04 14	W81-70138			153-05-70
TLITTING ROTORS				W81-70450
Integrated Avionic Control Systems for Rotorcraft				TROPICAL METEOROLOGY
505 42 31	W81 70085			Severe Storms and Local Weather Research
TIME				146-50-02
Frequency and Timing Research				W81 70344
310-10-62	W81 70577			TROPOAUSE
Network Timing and Synchronization Technology				Airborne Water Vapor Lidar
310 20 27	W81 70579			146-30 03
TIME MEASUREMENT				W81 70332
Shuttle Time and Frequency Transfer Experiment (STIFT)				TROPOSPHERE
676 59 41	W81 70409			Global Tropospheric Models Monitoring
Precision Time and Frequency Sources				146-20-08
310 10 42	W81 70574			W81 70327
TIN				Application of Remote Measurement Techniques to
Infrared Detector Materials Preparation				Tropospheric Air Quality Monitoring
179 80 10	W81 70372			146-20-10
TITAN				W81 70328
Aeronomy of Planetary Atmospheres	Chemistry			Theoretical Studies of the Upper Tropospheric Aerosol
154-75-80	W81 70472			Layer and Sahara Dust
TITANIUM				146-20 23
SCR-Materials and Structures				W81-70329
533 01 13	W81 70144			Airborne Water Vapor Lidar
TOPOGRAPHY				146 30 03
Ocean Circulation and Topography				Atmospheric Processes Experiments and Systems
146 40 07	W81 70337			147-10 03
Scatterometer Data Analysis				Stratospheric Research
146 40 12	W81 70338			147-30-02
Planetary Geology				Stratospheric Modeling
151 01 70	W81 70440			676-59 37
Mars Data Analysis Studies				Laser/VLBI Propagation Medium Analysis
155 20 70	W81 70481			W81-70408
TOWING				TUNABLE LASERS
Systems for Underwater Survey and Exploration (SUSE)				Multi-Spectral Detectors and Sensors
637-01 02	W81 70381			506 54-46
TOXICITY				W81 70211
Aircraft Fire Safety and Testing				Sensor Systems Technology
505-44 27	W81 70111			506 61-33
TRACE CONTAMINANTS				W81 70254
Theoretical Studies of the Upper Tropospheric Aerosol Layer and Sahara Dust				Sensor Systems
146-20 23	W81 70329			506 61-36
TRACKING (POSITION)				Semiconductor Materials Growth in Low-g
Instrument Pointing Systems				Environment
506-61-43	W81 70258			542-03 30
TRACKING NETWORKS				Atoms & Molecular Properties of Planetary Atmospheric Constituents
Network Systems Technology Development				154 50 80
310 20-33	W81 70580			W81 70465
TRACKING RADAR				TURBINE BLADES
Technology for TDRSS User Spacecraft				Turbine Engine Hot Section Technology (HOST)
310-20-46	W81 70582			510 57-12
X Band Uplink Development				W81 70120
310-20-64	W81 70583			TURBINE ENGINES
TRACKING STATIONS				Fan Compressor and Turbine Research
Navigation Technology Development				505-32 22
310-10-63	W81 70578			Composites for Propulsion Components
Station Monitor and Control Technology				505-33 32
310-30-68	W81 70587			Loads Dynamics and Aeroelasticity
TRACTION				505 33 52
Aircraft Systems Operational Safety and Efficiency Improvement				Electronic Aircraft Engine Control
505-44-31	W81-70114			505 34-32
Aircraft Landing Systems Efficiency Improvements				W81 70050
505 44-33	W81 70116			Combat Veh & Missile Aerodyn & Flight Dyn R & T
TRAFFIC				505 43-22
Concepts for Improved Ground Transportation Systems				Materials for Advanced Turbine Engines (MATE)
778 48-15	W81 70311			510-53 12
TRAFFIC CONTROL				Aeroelasticity of Turbine Engines
Concepts for Improved Ground Transportation Systems				510-55 12
778 48-15	W81 70311			Turbine Engine Hot Section Technology (HOST)
TRAINING ANALYSIS				510 57 12
Flight Management Systems				Advanced Rotorcraft Propulsion Technology
505 35-21	W81-70056			532 06 12
TRAINING DEVICES				W81 70141
Flight Management Systems				TURBINES
505 35-21	W81-70056			Advanced Reusable Main Engine Technology
Simulation Technology for Aeronautics				506 52-19
505 35-31	W81-70059			Solar Rankine Cycle Applications Study
TRAINING SIMULATORS				776 91-59
Application of Flight Simulation Technology				W81 70303
505-35-33	W81-70060			TURBOFAN ENGINES
TRAJECTORY ANALYSIS				High Temperature Structures
Attitude/Orbit Systems Technology				505-33 72
310 10 26	W81-70573			Broad Property Fuels Technology
				511 59 12
				Energy Efficient Engine Project
				535 01 12
				Advanced Turboprop Flight Research
				535 03 14
				TURBOFANS
				Fan Compressor and Turbine Research
				505 32 22
				Loads Dynamics and Aeroelasticity
				505-33-52
				W81 70039
				TURBOJET ENGINES
				Noise Reduction Technology for Short Haul Aircraft
				505-32-01
				Power Transfer Research
				505-32-42
				W81 70024
				TURBOMACHINERY
				Liquid-Chemical Propulsion Technology
				506 52-12
				W81 70180

TURBOPROP AIRCRAFT

- Advanced Turboprop Program 535-03 12 W81 70169
- Advanced Turboprop- Interior Noise 535 03 13 W81 70170
- Advanced Turboprop Flight Research 535 03 14 W81 70171

TURBOPROP ENGINES

- Heavy-Lift/Short Haul Hybrid Airship Technology 505-42 51 W81 70086

TURBULENCE

- Turbulence and Modeling 505 31 21 W81 70003
- Aviation Meteorology Research Atmospheric Dynamics & Measurement Tech 505 44 18 W81 70105
- Aviation Meteorology Research - Basic Atmospheric Processes 505-44 23 W81 70109
- Magnetospheric Physics - Particles and Particle/Field Interaction 170 36 55 W81 70491

TURBULENCE EFFECTS

- Basic Noise Research 505 32-05 W81 70019

TURBULENT METERS

- Computational and Experimental Aerothermodynamics 505-51 11 W81 70173

TURBULENT BOUNDARY LAYER

- Aeronautics Flight Experiments 505-31 44 W81 70009

TURBULENT FLOW

- Computational Methods and Applications in Fluid Dynamics 505 31 11 W81-70001
- Turbulence and Modeling 505 31-21 W81-70003
- Turbulent Drag Reduction 505-31 23 W81 70004
- Airfoil and Wing Development 505-31 31 W81 70005
- Hypersonic Propulsion Research 505 32 93 W81-70030
- Photophysics and Laser Diagnostics 506 54-41 W81-70207

U

UH 1 HELICOPTER

- Rotorcraft Aerodynamic Performance Dynamics and Handling Qualities 505-42 21 W81 70083
- Integrated Avionic Control Systems for Rotorcraft 505 42 31 W81 70085

ULTRAHIGH FREQUENCIES

- Analysis of Multifrequency/Multipolarization SAR Imagery 677 41 12 W81-70423

ULTRASONIC TESTS

- Life Prediction for Composite Materials 505 33-23 W81 70035

ULTRAVIOLET ASTRONOMY

- Extreme Ultraviolet Explorer 685-20 06 W81 70565
- Sounding Rockets Experiment 828-11 38 W81 70569
- Sounding Rockets Experiments (Astronomy) 879 11 41 W81 70571

ULTRAVIOLET LASERS

- Remote Sensing Systems 506 61 35 W81-70255

ULTRAVIOLET PHOTOGRAPHY

- Extreme Ultraviolet Explorer 685-20-06 W81-70565

ULTRAVIOLET RADIATION

- Long Term Space Environmental Effects on Materials 506-53 29 W81-70194
- Ground-Based Observations of the Sun 170-38 52 W81 70497
- UV and Optical Astronomy 188 41 51 W81 70501
- Global Terrestrial Ecology 199 70 31 W81 70546

ULTRAVIOLET SPECTROSCOPY

- Ultraviolet Spectroscopy of Planetary Atoms and Molecules 154 70-80 W81-70469

UNDERGROUND STORAGE

- In Situ Instrumentation for Developing Nuclear Waste Isolation Sites 775-16 27 W81 70298

UNDERWATER VEHICLES

- Systems for Underwater Survey and Exploration (SUSE) 637 01 02 W81 70381
- Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment - HEBBLE) 637 01-04 W81-70383

UNIVERSE

- Cosmic Background Explorer (COBE) 685 20-08 W81-70566

UNIVERSITIES

- Fund for Independent Research (Space) 506 56 13 W81 70246

UNIVERSITY PROGRAM

- Fund for Independent Research (Aeronautics) 505-36-13 W81-70063

CFD Training Program

- 505-36 20 W81 70065

Aeronautics Graduate Research Program

- FY 1981 505-36 21 W81 70066

Graduate Program in Aeronautics

- 505 36 23 W81 70068

Detection of Other Planetary Systems

- 196 41-68 W81 70524

UPLINKING

- Space Mission Uplink Process Control Architecture 540-01 15 W81-70278

UPPER ATMOSPHERE

- Shuttle Upper Atmospheric Mass Spectrometer (SUMS) 506 63 37 W81 70276

Improved Measurement and Calibration Techniques for Stratospheric Trace Species

- 146 60-01 W81 70348

Environmental Monitoring Research Satellite Mission Studies

- 146-60 02 W81 70349

Chemical Kinetics

- 147-20 01 W81 70358

Upper Atmosphere Research Theoretical Studies

- 147-30 01 W81 70360

Upper Atmosphere Research Satellites (UARS) Definition Study

- 147 40 01 W81-70365

Extended Atmospheres

- 154-80 80 W81 70474

UPWELLING WATER

- Coastal and Estuarine Dynamic Processes Research 146-40 15 W81 70342

URANIUM

- NASA/Geosat Test Case Study 677-41 02 W81 70418

URANUS ATMOSPHERE

- Optical Astronomy 196 41 71 W81 70525

URINE

- Prosthetic Urinary Sphincter Control Valving System 141-95 02 W81 70320

UROLOGY

- Prosthetic Urinary Sphincter Control Valving System 141 95 02 W81 70320

UTILITIES

- Utility Power Supply and Load Management 778-50 15 W81 70314

Communication Satellite Application Systems

- 643 10 02 W81 70377

UTILIZATION

- Seasat Data Utilization Project 146-01 00 W81 70322

V

V/STOL AIRCRAFT

- V/STOL Propulsion Research 505 42 62 W81 70087

Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research

- 505 42 71 W81 70088

AV-8A V/STOL Flight Experiments

- 505-42 74 W81 70089

Low Speed Aircraft Systems Studies

- 530 02 11 W81 70127

Tilt Rotor Research Aircraft Flight Investigations

- 532-04 11 W81-70137

Flight Test of the Tilt Rotor Research Aircraft

- 532-04 14 W81 70138

V/STOL Systems Technology

- 532-05 11 W81 70139

V/STOL Propulsion System Technology

- 532 05 12 W81 70140

VACUUM PUMPS

- Planetary Atmosphere Experiment Development 154 90 80 W81 70477

VANES

- Turbine Engine Hot Section Technology (HOST) 510 57 12 W81 70120

VAPOR PHASES

- Infrared Detector Materials Preparation 179 80 10 W81-70372

Planetary Clouds Particulates and Ices Clouds of Venus

- 154-30 80 W81-70462

VARIABILITY

- Upper Atmosphere Research Satellites (UARS) Definition Study 147 40 01 W81 70365

VARIABLE CYCLE ENGINES

- SCR Propulsion Technology 533 01 32 W81 70146

Propulsion System/Airframe Integration Technology

- 533 01 62 W81 70148

SCR Airframe/Propulsion System Interactions

- 533 01 63 W81 70149

Variable Cycle Engine Technology

- 535 02 12 W81 70168

VARIABLE GEOMETRY STRUCTURES

- Configuration Aerodynamics 505-31 43 W81 70008

VEGETATION

- High Spectral Resolution Remote Sensing 677 41 08 W81-70420

VENUS ATMOSPHERE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Dynamics of Planetary Atmospheres

- 154-20 80 W81 70460

Dynamic Radiative Interaction

- 154-20 80 W81 70461

Planetary Aeronomy Theory and Analysis

- 154 60 80 W81 70467

Extended Atmospheres

- 154 80 80 W81 70474

Optical Astronomy

- 199-41 71 W81 70525

VENUS CLOUDS

- Planetary Clouds Particulates and Ices Clouds of Venus 154 30 80 W81 70462

Clouds Particulates and Ices

- 154 30 80 W81 70463

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

Clouds Particulates and Ices

- 154 30 80 W81 70462

Aeronomy Chemistry

- 154 75 80 W81 70473

VENUS SURFACE

- Planetary Aeolian Processes on Planets 151 01 60 W81 70439

SUBJECT INDEX**X RAY ASTRONOMY**

Rotocraft Operating Systems Technology	W81 70133	WEATHER DATA RECORDERS Knowledge of High Altitude Atmospheric Processes	Experimental Methods and Instrumentation
532-01 11		505 44-14	W81 70103
VOLCANOES		WEATHER FORECASTING Severe Storms and Local Weather Research	505-31-53
Geological Mapping Kilauea Caldera Stratigraphy	W81 70421	146 50-02	Noise Reduction Technology for Short Haul Aircraft
677-41 09		146 50-02	505-32 01
VORTICES		Severe Storms and Local Weather Research	General Aviation Aerodynamic Performance Technology
Configuration Aerodynamics	W81 70008	146 50-02	505-41 11
505 31-43		W81 70345	General Aviation Aerodynamics and Handling Qualities
VOYAGER PROJECT		WEATHERING Mars Data Analysis Program	Technology
Planetary & Solar Spacecraft Systems Automated Optical		155 20-40	505-41-13
Navigation	W81-70265	Mars Data Analysis Program Geology	Rotocraft Aeroelasticity and Structural Dynamics
506-62-55		155 50-01	505 42-11
Planetary Geology	W81-70440	Composites	Heavy Lift/Short Haul Hybrid Airship Technology
151-01-70		505-33-33	505-42-51
Dynamic Radiative Interaction	W81 70461	Helicopter Transmission Technology	Flight Vehicle Dynamics
154-20-80		511 58-12	505-43-11
Clouds Particulates and Ices	W81 70463	SCR Materials and Structures	Flight Dynamics
154 30-80		533 01-13	505 43-13
Planetary Infrared Imaging	W81 70527	Utilization of Space for Science Experiments	High Performance Aircraft Airframe-Propulsion
196 41 77		506 56 29	Integration
Energetic Particles and Plasmas in the Magnetospheres		Spacelab 2 Superfluid Helium Experiment	505-43-21
of Jupiter and Saturn		542 03 13	Interagency and Industrial Assistance and Testing
385-36-04	W81 70558	Tribological Experiments in Zero Gravity	505 43-31
		542 03 27	Remotely Piloted Research Aircraft Technology
		Advanced Containerless Processing Technology	505-43-44
		179 20 55	Advanced Rotorcraft Systems Technology
		Fusion Target Technology Study	Materials and Noise
		179 20 57	532 06-13
		Space Motion Sickness	SRC Aerodynamic Performance Technology
		199 20 00	533 01 43
		Blood Alterations (Influence of Space Flight on the	Highly Maneuvering Aircraft Technology
		Blood Forming Tissues)	533 03 13
		199 20 50	Energy Efficient Transport Wind Tunnel Testing
		Fluid and Electrolyte Change	534 02-11
		199 20 60	Variable Cycle Engine Technology
		Man Machine Engineering Requirements for Data and	535-02-12
		Functional Interfaces	Aerodynamics of Ground Vehicles
		199 60 71	141 20-11
		W81 70544	Planetary Aeolian Processes on Planets
		WETLANDS Alaska Wetlands Delineation Program	151-01 60
		677 21 22	W81 70412
		WETTING Tribological Experiments in Zero Gravity	WIND TUNNEL WALLS
		542 03 27	Aerodynamic Test Methods and Instrumentation
		W81 70293	505 31-51
		WIDEBAND COMMUNICATION GHz Wideband Communications Satellite Project	W81 70010
		Definition	WIND TUNNELS
		650 60 18	Interagency and Industrial Assistance and Testing
		30/20 GHz Spacecraft Multibeam Antenna Technology	505 43-33
		650 60 20	W81-70097
		Satellite Switching and Processing Systems	WING LOADING
		650-60 21	Rotorcraft Structures Vibration Aeroelasticity and
		Radio Metric Analysis Demonstration and	Acoustics
		Instrumentation Development	505-42-13
		310-10 60	W81-70082
		W81-70575	Rotorcraft Aerodynamic Performance Dynamics and
		WIND (METEOROLOGY) Aviation Meteorology Research Basic Atmospheric	Handling Qualities
		Processes	505 42 21
		505-44 19	W81 70083
		Commercial Aircraft Fuel Savings	WING NACELLE CONFIGURATIONS
		505-44 32	Configuration Aerodynamics
		Advanced Ocean Sensor Systems Development	505 31-43
		146-40 13	W81-70008
		W81 70340	WING OSCILLATIONS
		Planetary Aeolian Processes on Planets	Decoupler Pylon Flight Demonstration
		151-01 60	533 02 73
		W81 70439	W81-70155
		WIND EROSION Planetary Aeolian Processes on Planets	WING PROFILES
		151-01 60	General Aviation Aerodynamic Performance Technology
		W81 70439	505-41 11
		Theoretical Studies of Planetary Bodies	WING TANKS
		151-02 60	Decoupler Pylon Flight Demonstration
		W81-70441	533 02 73
		WIND MEASUREMENT Commercial Aircraft Fuel Savings	W81 70155
		505-44 32	WINGLETS
		W81 70115	Configuration Aerodynamics
		WIND SHEAR Knowledge of High Altitude Atmospheric Processes	505 31 43
		505-44 14	Energy Efficient Transport Flight Research
		W81 70103	534 02 14
		Aviation Meteorology Research Atmospheric Dynamics	W81 70008
		& Measurement Tech	WINGS
		505-44 18	Composites
		W81-70105	505-33 33
		Aviation Meteorology Research Basic Atmospheric	Flight Loads and Aeroelasticity
		Processes	505-33 54
		505-44 19	Laminar Flow Control (Leading Edge Glove) - Flight
		W81 70106	Research
		Aviation Safety Technology -Flight Safety	534 01 14
		505-44 23	Energy Efficient Transport Flight Research
		W81 70109	534 02 14
		Aviation Operations Safety Technology - Wind Shear and	W81 70161
		Collision Avoidance	WORKING FLUIDS
		505-44 28	Solar Rankine Cycle Applications Study
		W81 70112	776-91 59
		WIND TUNNEL APPARATUS Experimental Methods and Instrumentation	W81 70303
		505-31-53	WORKLOADS (PSYCHOPHYSIOLOGY)
		W81-70011	Flight Management Systems
		WIND TUNNEL MODELS Full Space Reynolds Number Test Technology	505-35 21
		505 31 63	Human Factors Flight Research with High Performance
		W81 70013	Aircraft and RPVs
		Advanced V/StOL Aircraft Aerodynamics and Flight	505-35-24
		Dynamics Research	W81 70056
		505-42-71	
		W81 70088	
		WIND TUNNEL TESTS Aerodynamic Test Methods and Instrumentation	X
		505 31 51	
		W81-70010	X RAY ASTRONOMY
			Gamma-Ray Astronomy
			188-46 57
			W81 70511
			X-Ray Astronomy Time Variability and Polarimetry
			188 46 59
			W81 70512
			X-Ray Astronomy
			188-46 59
			W81-70513
			Advanced Mission Studies
			188-78 60
			W81-70517
			Theoretical High Energy Astrophysics
			389-46 03
			W81 70563
			X-Ray Astronomy Data Analysis
			389-46 04
			W81-70564

X RAY FLUORESCENCE

X Ray Timing Explorer (XTE) W81-70567
 685 20 11
 Sounding Rocket Experiments (High Energy
 Astrophysics) W81 70570
 879 11 46

X RAY FLUORESCENCE

Remote Sensing W81 70452
 153 07 40

X RAY IMAGERY

Advanced Mission Study Solar X-Ray Pinhole Satellite
 and Long Focal Length Coronagraph W81-70549
 356 38 01

X RAY SOURCES

UV and Optical Astronomy W81-70501
 188 41 51
 X Ray Astronomy - Time Variability and Polarimetry W81-70512
 188 46 59
 X Ray Astronomy W81 70513
 188 46 59
 X Ray Astronomy Data Analysis W81 70564
 389-46-04

X RAYS

X-Ray Gamma Ray and Neutron Gamma-Ray Methods
 for Planetary Exploration W81 70489
 157-03 50
 Ground Based Observations of the Sun W81 70497
 170-38 52

XV 15 AIRCRAFT

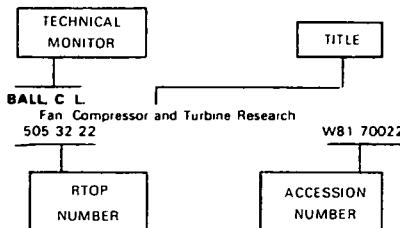
Rotorcraft Operating Systems Technology W81 70133
 532-01-11
 Tilt Rotor Research Aircraft Flight Investigations W81 70137
 532-04-11
 Flight Test of the Tilt Rotor Research Aircraft W81 70138
 532-04-14

MONITOR INDEX

FISCAL YEAR 1981

RTOP Summary

Typical Monitor Index Listing



A title is used to provide a more exact description of the subject matter. The RTOP accession number is used to locate the bibliographic citations and technical summaries in the Summary Section.

A

ABRAMS M J
NASA/Geosat Test Case Study
677 41 02 W81 70418
Geological Mapping Kilauea Caldera Stratigraphy
677 41 09 W81 70421

ABSHIRE J B
Laser/VLBI Propagation Medium Analysis
676-59 35 W81 70407

ALEXANDER J K
Radio and Radar Planetary Studies
196 41 51 W81 70521
Data Analysis - Space Plasma Physics
385-36 02 W81 70557

ALEXOVICH R E
Electrophysics
506 54 42 W81 70208
High Efficiency Technology for Microwave Amplifiers
506-61 22 W81 70250
Satellite Communications Technology
541-02 12 W81 70287

ALLARIO F
Application of Remote Measurement Techniques to
Tropospheric Air Quality Monitoring
146 20-10 W81 70328
Laser Heterodyne Spectrometer (LHS) Brassboard
147 40 01 W81 70366

ALLENBY R J
Regional Crustal Deformation Modeling
676-10-10 W81 70402

ANANDA M P
Navigation Technology Development
310-10-63 W81 70578

ANDERSON K F
Flight Research Instrumentation Development
505-31-54 W81 70012

ANDERSON W J
Power Transfer Research
505-32 42 W81-70024

ANDREWS W H
Remotely Piloted Research Aircraft Technology
505-43-44 W81-70099

ARENDS J F
Signal Detection and Processing
506 54 56 W81-70213

ARKING A
Climate Research
146 10 03 W81-70324

ARNOLD J O
Surface Physics and Computational Chemistry
506 53 11 W81-70188

ARRINGTON J
Space Shuttle Development Support
506 63 13 W81-70269

ARRINGTON J P
Space Vehicle Aerothermodynamics and Configuration
Technology
506 51 13 W81 70174

Technology Requirements of Future Integrated Space Transportation Systems
540 03-13 W81 70284

AXLEY B D
Aircraft Operational Support
505 43 54 W81-70100

AYERS T G
Space Shuttle Aerodynamic Experiments
506-51 34 W81-70179

B

BAGWELL J W
Great Lakes Water Quality Research
146-40 18 W81-70343

BALES T T
SCR Materials and Structures
533-01 13 W81-70144

BALL C L
Fan Compressor and Turbine Research
505-32 22 W81-70022
Aeroelasticity of Turbine Engines
510-55 12 W81-70119

BARBER M R
Energy Efficient Transport Flight Research
534-02 14 W81-70161

BARNES A
Magnetospheric Physics
Interaction
170-36-55 W81-70491

BARNES C M
Radiation Effects and Protection RTOP
199-20-70 W81-70541

BARNWELL R W
Aircraft Development
505 31-33 W81-70006

BARON R S
Laminar Flow Control (Leading Edge Glove) - Flight Research
534-01-14 W81 70158

BEER R
Advanced Turboprop Flight Research
535 03-14 W81 70171

BEJCZY A K
Man Machine Systems
199 60-60 W81 70543

BELL D. III
Regenerative Fuel Cell/Hydrogen/Halogen
776 91-17 W81 70299

BEREMAND D G
Starling Engine Components and System Concepts
778 46 22 W81 70307

BERGESON WILLIS S
Gravity Field Survey Mission (GRAVSAT) Phase B
Studies
677 29 04 W81 70415

BERGSTRALH J T
Planetary Atmospheres Composition and Structure
154 10-80 W81 70458

BERRY, D T
Human Factors Flight Research with High Performance
Aircraft and RPVs
505 35 24 W81 70058

BILLIS B G
Flight Dynamics and Handling Qualities
155 20 70 W81 70481

BERSCH C
Interdisciplinary Research in Composite Structures
505 33 60 W81 70042

BILLS B G
Mars Data Analysis Studies
155 20 70 W81 70481

BLACK D C
Theoretical Infrared and Radio Astrophysics
188 41 55 W81 70506

BLACKWELL R J
Registration of Radar and Other Data
656 45 02 W81 70399

BLAKENSHIP C P
Composites for Propulsion Components
505 33 32 W81 70037

BLANCHARD D P
Integrated Study of Continental Rift Systems
677 43 05 W81 70427

BLANCHARD R C
Shuttle Upper Atmospheric Mass Spectrometer
(SUMS)
506-63-37 W81-70276

BLANKENSHIP C P
Materials for Advanced Turbine Engines (MATE)
510 53-12 W81-70117

BOESE R W
Quantitative Infrared Spectroscopy of Minor Constituents
of the Earth's Stratosphere
147 20-03 W81-70359

BOGESS A
UV and Optical Astronomy
188 41 51 W81 70502

BOHON H L
Composite Components Technology
534 03 13 W81 70162

Large Composite Primary Aircraft Structures (LCPAS)
Key Technology
534-03 33 W81 70163

BOLDT E A
X-Ray Astronomy
188 46 59 W81 70513

Sounding Rocket Experiments (High Energy
Astrophysics)
879-11 46 W81 70570

BOREHAM J F
High Speed Data Transfer X/S Band Components
506-61 25 W81 70251

BOWDITCH D N
Inlet Nozzle and Propeller Research
505-32 12 W81 70020

Combat Veh & Missile Aerodyn & Flight Dyn R & T
505-43 22 W81 70094

Propulsion System/Airframe Integration Technology
533-01 62 W81-70148

BOWLES R L
Application of Flight Simulation Technology
505-35 33 W81 70060

BRANDHORST H W
Solar Cell Technology
506-55 42 W81 70233

BRANDT J C
Imaging Studies of Comets
196-41 52 W81 70522

BRIDGEFORTH A O
Planetary Power Systems R & T
506-55 75 W81 70241

BROWELL E V
Airborne Water Vapor Lidar
146-30-03 W81 70332

BROWN G V
Loads Dynamics and Aeroelasticity
505 33 52 W81 70039

BROWN W E JR
Radar Spectrometer
677 27-04 W81 70414

BRUNK, W E
Ground-Based Optical Planetary Astronomy
196 41-80 W81 70529

Astronomical Optical Instrument Development
196 41-81 W81 70530

Laboratory Supporting Studies (Astronomy)
196 41 84 W81-70531

Ground Based Radio and Radar Planetary Astronomy
196-41 85 W81 70532

Theoretical Planetary Astronomy
196-41 85 W81 70533

BRYANT R G
Interagency Assistance and Testing
505-43 34 W81 70098

BURR P T
Upper Atmosphere Research Satellites (UARS) Definition
Study
147-40 01 W81 70365

BUSHNELL, D M
Turbulent Drag Reduction
505 31 23 W81 70004

BUTLER P JR
Curation of Extraterrestrial Samples
152 04 40 W81-70444

C

CAMP D W
Aviation Meteorology Research Basic Atmospheric
Processes
505 44-19 W81 70106

CAMPBELL, J W
Coastal and Estuarine Dynamic Processes Research
146 40 15 W81 70341

CARD M F	Advanced Space Structures	W81 70199	CROUCH R K	Semiconductor Materials Growth in Low g		E
506 53 43	Loads Dynamics and Aeroelasticity	W81-70202	Environment	W81 70294	EDENBOROUGH H K	
506 53 63			542-03 30		Advanced Rotor Operations	Systems Technology/RSRA
CARO E R	NASA Airborne Imaging Radar Facility	W81 70434	Infrared Detector Materials Research	W81 70371	532 03 11	W81-70136
677-47 03			179-80-10		EDGE J T	
CAROFF L J	Theoretical Studies of Galaxies and Quasi Stellar Objects	W81 70503	Far Outer Planets Spacecraft Technology Definition	W81 70282	Aircraft Controls Technology	Electromechanical Actuator
188 41 51			540 02-15		505-34 37	W81 70053
CARR R E	Theoretical Studies of Galaxies and Quasi Stellar Objects	W81 70503	Advanced Carbon-Carbon Stand Off Panel	W81-70197	ELACHI C	
505-44 18			506 53 37		Rock Type/Microwave Techniques (Imaging Radar Geology)	
505-44 28	Aviation Meteorology Research Atmospheric Dynamics & Measurement Tech	W81 70105			677-41 04	W81-70419
505-44 28	Aviation Operations Safety Technology	W81-70112	Advanced Mission Study Solar X Ray Pinhole Satellite and Long Focal Length Coronagraph	W81 70549	Radar Studies	
505-44 28	Wind Shear and Collision Avoidance		356 38 01		153 07 70	W81-70453
CARTER A L	Flight Loads and Aeroelasticity	W81 70041	DAIBLEY C C	Advanced Mission Studies	ELLIOTT J R	
505 33 54			188 78 60	W81-70517	Aircraft Controls Theory and Techniques	
CASSEN P M	Formation Evolution and Stability of Proto Stellar Disks	W81 70446	DANIELSEN E F	Stratospheric Research	505 34 33	W81 70051
153 01 60			147-30 02	W81 70363	Thermal Management for On Orbit Energy Systems	
CAW L J	Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F 111)	W81-70150	Planetary Aeolian Processes on Planets	W81 70439	506 62 67	W81 70267
533 02 14			151 01 60		ELSWORTH C R	
CHAHINE M	Radiative Transfer in Cloudy Atmosphere	W81 70464	DE GROOT N F	Remote Sensing Frequency Coordination Studies	Ocean Thermal Energy Conversion Study and Assessment	
154 40-80			643 10 04	W81 70380	776 91 40	W81-70302
CHAMBERS J R	Flight Dynamics	W81 70091	DECHER R	Fund for Independent Research	Coal Conversion Processes and Systems	
505 43 13			506-56 19	W81 70248	778-47 29	W81-70310
CHAMIS C C	Integrated Analysis and Synthesis	W81 70043	Shuttle Time and Frequency Transfer Experiment (STIFT)		Advanced Energy Technology for Utilities	
505 33 62			676-59 41	W81-70409	778 50 29	W81 70315
CHAPMAN G	Aeronautics Graduate Research Program FY 1981	W81-70066	Low Gravity Superfluid Helium Advanced Technology Development		ENGLAND A W	
505-36 21			188-78 51	W81 70515	Theoretical Studies of Radar Backscatter	
CHAPMAN G T	Funds for Independent Research (Aeronautics)	W81-70061	DECKERT W H	Heavy Lift/Short Haul Hybrid Airship Technology	677 41 11	W81 70422
505 36-11			505-42 51	W81 70086	ENGLISH R D	
506 56 11	Funds for Independent Research (Space)	W81 70244	DEGNAN J J	Sensor Systems	Long Duration Exposure Facility	
506 56 11			506 61 36	W81 70256	542 04 13	W81 70296
CHAPMAN R D	Development of Solar Spacelab Experiment and Hardware	W81 70496	DEMORÉ W B	Chemical Kinetics	ERICKSON W D	
170-38 51			147-20 01	W81 70358	Applied Mathematics	
Experiment Development	Laboratory and Theoretical Solar Physics		DENERY D G	General Aviation Advanced Avionics Systems	505 31 83	W81 70015
170 38 53			531-01 11	W81 70132	Fund for Independent Research (Aeronautics)	
385 38 01	Solar Physics Data Analysis and Operations	W81-70559	DEXTER H B	Advanced Rotorcraft Systems Technology Materials and Noise	505 36 13	W81 70063
385 38 01			532 06-13	W81 70142	Graduate Program in Aeronautics	
828 11-38	Sounding Rockets Experiment	W81 70569	DIETLEIN L F	Interdisciplinary Research	505 36 23	W81 70068
828 11-38			199 90 71	W81-70547	Fund for Independent Research (Space)	
CHAPPELL C R	Particle and Particle Field Interactions	W81 70490	DIXON S C	High Temperature Aeronautical Structures	506 56 13	W81 70246
170 36 55			505 33 73	W81-70046	ERZBERGER H	
Magnetospheric Data Analysis			506-53 33	W81 70196	Navigation and Guidance Short Range Operations	
385 36 01			DONN B	Cosmic Chemistry Aeronomy Comets Grains	505 34 11	W81 70047
CHELTON D B	Scatterometer Data Analysis	W81-70338	W81 70471		F	
146 40 12			DOWNING D R	General Aviation Avionics and Control Technology		
CHI A R	Network Timing and Synchronization Technology	W81 70579	505 41 63	W81-70077	FANSELOW J L	
310 20 27			530 04 13	W81-70130	VLBI Development and Analysis	
CHRISTENSEN M	Planetary Protection Program	W81 70542	DOWNS G S	High Speed Signal Processing Research	310 10 61	W81 70576
199 50 94			310 30 70	W81 70589	FAYE A	
CIEPLUCH C C	V/STOL Propulsion Research	W81 70087	DRAIN D I	Electronic Aircraft Engine Control	Advanced V/STOL Aircraft Aerodynamics and Flight Dynamics Research	
505 42 62			505-34 32	W81 70050	505 42 71	W81 70088
V/STOL Propulsion System Technology			DRIVER, C	Long Haul Transport Aircraft Systems Studies	V/STOL Systems Technology	
532-05 12	Advanced Rotorcraft Propulsion Technology	W81-70140	530 04 13	W81-70130	532 05 11	W81 70139
532-06 12			DUGAN J F	SRC Aerodynamic Performance Technology	F	
CLAUSS R C	Radio Systems Development	W81-70141	533-01 43	W81-70147	Propulsion Noise Research	
310-20 66			533 01 63	W81 70149	Extended Scene Radar Calibration	
COCHRAN T H	Advanced Energetics	W81 70226	535 03 12	W81 70169	677 47 02	W81 70433
506 55-12			535 03 12	W81 70169	FEW D D	
Space Propulsion and Power System Studies		W81 70281	DUKE M B	Analysis of Multifrequency/Multipolarization SAR Imagery	Tilt Rotor Research Aircraft Flight Investigations	
540 02-12			677-41 12	W81 70423	532 04 11	W81 70137
Cryogenic Fluid Management			677-43 01	W81-70425	FICHTEL C E	
542 03-52			152 05 40	JSC General Operations Support - Planetary Materials	Gamma Ray Astronomy	
COCHRANE J	Quiet Propulsive-Lift Technology Experiments Aircraft Performance and Operating Systems Research	W81-70134	153 01 10	W81 70445	188 46-57	W81 70510
532 02 11			153 10 40	W81 70456	FICHTEL G H	
CONRATH B J	Mars Data Analysis	W81-70478	506 63 34	DUNAVANT J C	Utilization of Space for Science Experiments	
155-04 80			DUGAN J F	Shuttle Infrared Leeside Temperature Sensing (SILTS)	506 56 29	W81 70249
CONWAY E J	Solar Cell Research	W81-70234	506 63 34	W81 70273	FIELDS R A	
506-55 43			DUNAVANT J C	Shuttle Infrared Leeside Temperature Sensing (SILTS)	Loads Dynamics and Aeroelasticity	
CROSWELL W F	Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	W81 70382	506 63 34	W81 70273	506 53 64	W81 70203
637-01 03					FINKE R C	
COYNE R J	Advanced Propulsion Technology	W81 70446			Electric Propulsion Technology	
506 55 22					506 55 22	W81 70230
Ion Thruster Research and Ion Beam Applications					506 55 32	W81 70231
506 55 32					Power Systems Management and Distribution	
Power Systems Management and Distribution					506 55-72	W81 70240
506 55-72					Earth Orbital Platform Systems	Auxiliary Electric Propulsion for Spacecraft Systems
Earth Orbital Platform Systems					506 62 62	W81 70266
Auxiliary Electric Propulsion for Spacecraft Systems					506 62 62	W81 70266
506 62 62					Petrology Lab	
506 62 62					153 02-70	W81 70448
Petrology Lab					153 02-70	W81 70448
153 02-70					Station Monitor and Control Technology	
153 02-70					310 30 68	W81 70587
Station Monitor and Control Technology					FRAMAN E P	
310 30 68					Utility Power Supply and Load Management	
310 30 68					778-50 15	W81 70314

MONITOR INDEX
JOHNSON, W

FREWING K Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment--HEBBLE) 637-01-04	W81-70383	Broad Property Fuels Technology 511-59-12	W81-70123	Turbine Engine Hot Section Technology (HOST) 510 57-12	W81 70120
FULTON R E Integrated Programs for Aerospace Vehicle Design (IPAD) 510 54-13	W81-70118	GULIZIA W Systems for Underwater Survey and Exploration (SUSE) 637-01 02	W81-70381	HOBBS R W Ground-Based Observations of the Sun 170-38-52	W81 70497
GARDNER E A ADS Oceanic Pilot System Project 656-13-40	W81-70394	GULKIS S Radio Astronomy 188-41 55	W81 70507	HOCKENSMITH R P Technology for TDRSS User Spacecraft 310 20-46	W81 70582
GARY B L Microwave Technology Development for Atmospheric Turbulence Studies 505 44 15	W81-70104	HAGYARD M J Development of Experiments and Hardware for Solar Physics Research 170-38 51	W81 70495	HOHL F Advanced Radiant Energy Conversion 508-55-13	W81 70227
GATLIN D H AV-8A V/STOL Flight Experiments 505 42-74	W81-70089	Ground-Based Observations of the Sun 170-38-52	W81-70498	HOMICK J L Space Motion Sickness 199-20 00	W81 70538
GAUSE, R. L. Long-Term Space Environmental Effects on Materials 506 53-29	W81-70194	Data Analysis Solar Physics 385-38 01	W81 70560	HOOD R V Energy Efficient Transport 534 02-13	W81 70160
GEDNEY R T GHz Wideband Communications Satellite Project Definition 650 60-18	W81-70385	HALL A W General Aviation Aerodynamics and Handling Qualities Technology 505-41 13	W81 70071	HOWELL D Oceanic Data Utilization System Study 656 13 60	W81 70395
30/20 GHz Spacecraft Multibeam Antenna Technology 650 60-20	W81-70386	Aerial Applications Aerodynamics and Systems Interaction 505-41 83	W81-70080	HUBBARD, H H Propulsion Noise Research 505-32 03	W81 70018
Satellite Switching and Processing Systems 650 60-21	W81-70387	Aviation Meteorology Research Severe Storms 505-44 13	W81 70102	HUDSON R D Upper Atmosphere Research Field Measurements 147 10-01	W81 70352
Communications System Components 650 60-22	W81-70388	Aviation Safety Technology Flight Safety 505 44-23	W81 70109	Upper Atmosphere Research - Laboratory Measurements 147 20 01	W81 70357
Communications Systems Breadboard 650 60 23	W81 70389	HALLAM K Fiber Optically Mosaiced Large Area Image Sensors 188 41 54	W81-70504	Upper Atmosphere Research Theoretical Studies 147-30 01	W81 70360
GEE S W AFTI/F 16 533 02-64	W81-70154	HANNER M S Clouds Particulates and Ices 154-30 80	W81 70463	HUNING J R ADS Pilot Geosciences Information Network Development 656 13 70	W81 70396
GELLER M Atomic and Molecular Properties 154 50-80	W81 70466	HANSEN J Numerical Climate Modeling 146-10 02	W81 70323	HUNTRASS, W T Stratospheric Research Field Measurements Program 147 10-02	W81 70354
GERKE P D OEX (Orbiter Experiments) Project Support 506 63 31	W81 70271	Stratospheric Modeling 147 30 02	W81-70364	Aeronomy Theory and Analysis 154-60 80	W81 70468
GIN W High Energy Chemical Propulsion Technology for Planetary Spacecraft 506 52 25	W81-70183	HARRIS, J. E Atmospheric Lidar System Definition 146-60 03	W81 70350	Aeronomy Chemistry 154 75 80	W81 70473
Advanced Chemical Propulsion Concepts For Planetary Spacecraft 506 52-35	W81 70185	HARRISON E F Environmental Monitoring Research Satellite Mission Studies 146-60 02	W81 70349	I	
GITELMAN J J Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame 540 01 16	W81 70279	HARTLE R E Planetary Aeronomy Theory and Analysis 154-60 80	W81-70467	ISE R Shuttle Operational Flight Test of the Solar Electric Propulsion Solar Array 542 03 04	W81 70290
GOETZ A F H Aircraft Thermal Infrared Scanner 677 47 01	W81 70432	Atmosphere-Ionosphere Magnetosphere Interactions 385 36 01	W81 70554	J	
GOLDSTEIN M E Fund for Independent Research (Aeronautics) 505 36-12	W81 70062	HARTMANN M J Computational Fluid Mechanics for Turbomachinery 505-32 52	W81-70025	JACKSON, C M Combat Vehicle and Missile Aerodynamics and Flight Dynamics 505 43 23	W81 70095
Graduate Research Program in Aeronautics 505 36-22	W81 70067	HASBACH W A Planetary Solar Array Research and Technology 506-55 45	W81-70235	JACKSON F. C Remote Sensing of Air Sea Interactions Phenomena 146 40 05	W81 70335
Fund for Independent Research (Space) 505 56-12	W81 70245	HATFIELD J J Cockpit Avionics Generic 505 34 23	W81 70048	JACOBSON A S Gamma Ray Astronomy 188 46 57	W81 70511
GOLUB M A Aircraft Systems Operational Safety and Efficiency Improvement 505 44 31	W81 70114	HEATH D F Ozone Data Reduction and Analysis and Solar UV Variability 146-60 01	W81 70346	JAIN A Ocean Wave Height Determination with the Synthetic Aperture Radar 146-40 05	W81 70334
Signal Processing and Detection High Density Circuit Technology 506 54-59	W81 70214	HEIMBUCH A H Fire Resistant Materials 505-33 31	W81-70036	JAMES R L Large Space Structures Systems Technology 506 62 43	W81 70264
GRAVES J R Multi-KW Low Cost Earth Orbital Systems 506 55 79	W81 70243	HELMES R Prosthetic Urinary Sphincter Control Valving System 141 95-02	W81 70320	JANESICK J R Advanced CCD Camera Development 157 01 01	W81 70486
Studies in Bioenergy 776 91-35	W81 70301	HENDERSON W P Propulsion System Integration 505 32 13	W81-70021	JARVIS C R Advanced Guidance and Control Flight Systems Experiments 512-54 14	W81 70125
GREENFIELD M A Space Engineering 506 53 10	W81 70187	Highly Maneuvering Aircraft Technology 505-03 13	W81 70156	JAYROE R R Ocular Screening System 141-95 02	W81-70321
GREGORY T J High Performance Aircraft Airframe Propulsion Integration 505-43 21	W81 70093	HEPPNER J P Particle and Particle/Photon Interactions (Atmospheric Magnetospheric Coupling) 170-36 56	W81 70493	JENNINGS P E Atomic & Molecular Properties of Planetary Atmospheric Constituents 154 50 80	W81 70465
Materials Science 506 53 12	W81 70189	Sounding Rockets Magnetospheric Physics Experiments 828-11 36	W81-70568	JOHNS, R H High Temperature Structures 505-33 72	W81 70045
GROBMAN J Fuels Research 505-32 72	W81 70027	HIBBARD W X Ray Timing Explorer (XTE) 685 20 11	W81 70567	JOHNSON M S Numerical Aerodynamic Simulator (NAS Project) 536-01 11	W81-70172
GRISAFFE S J Materials Science		HICKLEY D H Noise Reduction Technology for Short-Haul Aircraft 505 32-01	W81 70016	JOHNSON, T. V Optical Astronomy 196 41 71	W81-70525
		HICKS R General Aviation Aerodynamic Performance Technology 505 41-11	W81 70070	Earth Based Solar System Observations 196-41 78	W81 70528
		HINKLEY E D Quantum Electronics Sources 506-54 45	W81-70210	JOHNSON, W Rotocraft Aeroelasticity and Structural Dynamics 505 42-11	W81-70081
		HIRSCHBERG M H Life Prediction 505 33-22	W81-70034	Rotocraft Aerodynamic Performance Dynamics and Handling Qualities 505 42 21	W81 70083

JOHNSTON A R Data Transmission and Processing Research 506-54-55	W81 70212	KURKOWSKI R L Aviation Safety Technology Operational Problems and Fireworthiness 505-44-21	W81 70107	MASERJIAN J Fundamental Electronics 506-54-65	W81 70217
JOHNSTON N J Composites 505-33-33	W81 70038			MASSIER P F Basic Noise Research 505 32 05	W81 70019
JONES J J Planetary Probe Technology 506-51 23	W81 70176	L		505 44 25	W81 70110
Aerodynamic/Aerothermodynamic Flight Data Analysis 506 51 33	W81 70178	LABOVITZ M Geobotanical Test Site Investigations 677 42 01	W81 70424	MAURY J L Autonomous Process Control Technology for Earth Orbital Missions 506-54-76	W81 70221
JONES R A Hypersonic Propulsion Research 505 32 93	W81 70030	LAGOMARZINI G Spacelab 2 Superfluid Helium Experiment 542 03 13	W81 70291	MCBRYAR H Orbital Energy Storage and Power Systems (H2/02) 506-55-57	W81-70238
JONES W L Microscale Ocean Surface Dynamics 146 40 05	W81 70333	LANG H Pipeline/Nuclear Plant Engineering Geology 677 44 01	W81 70428	MCCALEB F W Image Processing Technology 310-40-46	W81 70593
	K	LANGEL R A Magstar Correlative Studies 677-45-04	W81-70431	MCCARTY J L Aircraft Landing Systems Efficiency Improvements 505 44 33	W81 70116
KAHLE A B High Spectral Resolution Remote Sensing 677-41-08	W81 70420	LARSEN R L Systems Management Technology 310 40 49	W81 70594	MCCLEESE D J Atmospheric Experiment Development 154 90 80	W81 70476
KAHN W D Advanced Geodynamics Studies 676 59-30	W81 70405	LARSON H K Planetary Probe Aerothermodynamic Technology 506 51 21	W81 70175	MCCORMICK M P Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere 147 10 02	W81 70355
KEAFER L S Information Systems for Earth Observations for Space 540 01 13	W81 70277	L		MCCREIGHT C R Infrared Detectors Far IR Sensors 506-61 31	W81 70253
KECKLER C R Instrument Pointing Systems 506 61 43	W81-70258	LEACH C S Blood Alterations (Influence of Space Flight on the Blood Forming Tissues) 199 20 50	W81 70177	MCDONALD, F B Particle Astrophysics and Shuttle Experiment Definition 188-46 56	W81 70509
KEITH J E In-Situ Instrumentation for Developing Nuclear Waste Isolation Sites 775 16 27	W81 70298	Fluid and Electrolyte Change 199 20-20	W81 70539	High Energy Astrophysics Data Analysis 389 46 01	W81 70562
KELLY W L NASA End-to-End Data System Information Adaptive System 506-61-53	W81 70260	LEANG C F Seasat Digital SAR Processing (Non Renewable Resources) 677 48 01	W81 70435	MCGARRY, F E Software Engineering Technology 310 10 23	W81 70572
KENNEDY R C Large Space Structure System Engineering 906-55-00	W81 70598	Seasat Digital SAR Processing (Renewable Resources) 677 76 01	W81 70436	MCGOOGAN J T Advanced Ocean Sensor Systems Development 146 40 13	W81-70339
Satellite Services 906-75-00	W81 70599	LESSING H C Advanced Guidance and Control Systems Validation Technology 512 54 11	W81 70124	MCKENZIE R L Photophysics and Laser Diagnostics 506-54-41	W81 70207
KERRISK D Acoustic Containerless Experiment System (ACES) 179-70-10	W81 70370	LEVY R Antenna Systems Development 310 20 65	W81 70584	MCLINNEY L W Full Space Reynolds Number Test Technology 505 31-63	W81 70013
KILGORE R A Experimental Methods and Instrumentation 505 31 53	W81-70011	LEWIS J L Man Machine Engineering Requirements for Data and Functional Interfaces 199 60 71	W81 70544	MCTAVISH C J Operations Support Computing Technology 310-40 26	W81 70590
KIM H H Coastal and Estuarine Dynamic Processes Research 146 40 15	W81 70342	LINDOR W I Remotely-Sensed Electromagnetic Characteristics of Snow and Soil Moisture 677 22 12	W81 70413	MEAD J M Data Analysis Astronomy 389-41-01	W81 70561
KLEIN H P Flight Management Systems 505 35 21	W81 70056	LINICK T D Automation of Space Mission Uplink Process Control 506 54-75	W81 70220	MEINTEL A J Automated Decision Making and Problem Solving 506 54 73	W81 70219
Simulation Technology for Aeronautics 505 35-31	W81 70059	Space Mission Uplink Process Control Architecture 540 01-15	W81 70278	MEISENHOLDER G W Validation of Stirling Lab Engine 778-46-35	W81 70308
KLUMPP A R Planetary & Solar Spacecraft Systems Automated Optical Navigation 506 62 55	W81 70265	LOHMAN G M Applications Data Base Management System (ADBMS) 656-31 02	W81 70397	Concepts for Improved Ground Transportation Systems 778-48 15	W81 70311
KNAUP G OSTA/ADS Data Systems Standards and Guidelines Program 656-13-10	W81 70391	LONGANECKER G W Origins of Plasma in the Earth's Neighborhood (OPEN) 171 03 00	W81-70500	MELSON W E General Aviation Aircraft Aerodynamics and Flight Dynamics 505 41-18	W81 70072
Full Scale Applications Data Service (ADS) Planning Studies 656-13-20	W81 70392	Cosmic Background Explorer (COBE) 685 20 08	W81-70566	General Aviation Avionics and Controls 505 41-68	W81 70078
Applications Data Service (ADS) Atmospheric Pilot System 656 13-30	W81 70393	LORD D D NASA End to End Data System 506 61 55	W81 70261	MERCANTI E P Demonstration Flight System and Operational Land Observing System (OLOS) 677 29-06	W81 70416
KNIGHT R M Flight Test of an Ion Auxiliary Propulsion System (IAPS) 542 05 12	W81 70297	LUIDENS R Aviation Operations Safety Technology 505 44 22	W81 70108	METZGER A E Instrument Definition 157 03 01	W81 70487
KOCH B M SCR Materials and Structures Flight Research 533 01 14	W81 70145	LUIDENS R W Aviation Meteorology Research 505 44 12	W81 70101	MEYER G Integrated Avionic Control Systems for Rotorcraft 505 42 31	W81 70085
High Performance Aircraft Flight Test Support 533 02 24	W81-70151			MIHALOV J D Pioneer 6 11 Plasma Data Analysis 385 36 01	W81 70556
Integrated Research Aircraft Control Technology 533 02 44	W81-70153	M		MIKKELSON D C Low Speed Propeller Research 505 41 52	W81 70076
KOLBY R B X-Band Uplink Development 310 20 64	W81-70583	MACE W Integration and Interfacing Technology 505 34 43	W81 70054	MIKULAS M M Failure and Thermal Analysis 506 53 53	W81 70200
KOONTZ O L NASA Ames Research Center Vertical Gun Facility 153 08-60	W81-70455	MADDALON D V Interagency and Industrial Assistance and Testing 505-43 33	W81 70097	MILLARD J P Remote Sensing of Subsurface Drain Malfunctions 141 20 21	W81 70317
KORDES E E Funds for Independent Research 505-36-14	W81 70064	MALCOLM G N Flight Vehicle Dynamics 505 43-11	W81 70090	MILLER, E F Technical Consultation Services 643-10 01	W81 70376
University Research in Flight Testing Techniques 505-36-24	W81 70069	MARSH, J G Ocean Circulation and Topography 146 40-07	W81 70337	MOACANIN J Fundamentals of Mechanical Behavior of Composites Matrices 506-53 15	W81-70190
KOSTIUK T Fund for Independent Research 506-56-16	W81 70247	MARVIN, J G Computational and Experimental Aerothermodynamics 506 51 11	W81 70173	Effects of Space Environment on Composites 506-53-25	W81-70193
KRISHEN, K Advanced Synthetic Aperture Radar Technology 506-61-37	W81 70257	Space Shuttle Aerothermodynamics 506 63 11	W81 70268	MOND T J F Thermal Electric and Thermionic Energy Conversion Technology 506-55 65	W81 70239
KUNDE V G Ground Based Infrared Astronomy 196 41 50	W81 70520				

MONTGOMERY D R Commercial Fisheries Ocean Forecast Demonstration 663 90 03	WB1 70401	Advanced Low Emission Combustor (ALEC) 511 55-12	WB1 70121	Rotorcraft Structures Vibration Aeroelasticity and Acoustics 505-42-13	WB1 70082
MUMMA M J Infrared and Radio Astronomy 188 41-55	WB1 70505	Combustion Technology for Power Generation 778 45 12	WB1 70304	Decoupler Pylon Flight Demonstration 533 02-73	WB1 70155
Astrophysics 196 41-54	WB1-70523	PHEN, R L Advanced Coal Processing Concepts 778 47-15	WB1 70309	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
MURACA R J Laminar Flow Control 534-01 13	WB1 70157	Tectonic Structure in Pakستان 677 43-03	WB1 70426	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
MURPHY J P Space System Studies Information and Spacecraft Systems 540-02 11	WB1 70280	Experimental Studies 153 02-40	WB1-70447	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
N					
NACHTWEY D S Global Terrestrial Ecology 199-70-31	WB1-70546	Interior Models 153 03-42	WB1-70449	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NAKAMURA Y Industrial Conservation Cogeneration and Utilization of Alternative Fuels 778-49-15	WB1-70313	Remote Sensing 153 07 40	WB1 70452	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NEEDLEMAN H C Airborne Experiment Platforms 530-02-18	WB1-70128	Mars Data Analysis Program 155 20 40	WB1 70480	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NEIL E A Global Weather Research 146-30-02	WB1 70330	Mars Data Analysis Program Geology 155 50-01	WB1-70483	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NEILSON G Glass Research 179-80-30	WB1 70373	PIERESON R G Synthetic Aperture Radar Processor 656 62-01	WB1 70400	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NELSON H G Fatigue Damage and Environmental Effects in Metals and Composites 505-33-21	WB1-70033	PIRAGLIA J A Planetary Atmospheric Dynamics 154 20 80	WB1 70459	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NICHOLS, G E JR Energy Planning Support at JPL 778 45-35	WB1-70305	POLIFKA R W Advanced Manned Vehicle Onboard Propulsion Technology 506 52 17	WB1 70181	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NIEMANN H B Planetary Atmosphere Experiment Development 154 90-80	WB1-70477	POLLACK J B Aerosol Climatic Effects Special Study 148 10 04	WB1 70325	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
NORTHROP T G Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn 385 36-04	WB1-70558	Theoretical Studies of Planetary Bodies 151 02 60	WB1 70441	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
O					
O'DELL, C R Cometary Observation and Theory 196 41-30	WB1-70518	Planetary Atmospheric Composition and Structure 154 10 80	WB1 70457	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
OCHELTREE S L Quantum Electronics Devices and Sensors 506 54-43	WB1 70209	Planetary Atmospheres Data Analysis 155 04 80	WB1 70479	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
Sensor Systems Technology 506-61-33	WB1 70254	POOL S L Medical Selection Criteria (Medical Evaluation and Development of Standards for Space Crew Selection) 199 10 20	WB1 70535	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
ODELL, C R UV and Optical Astronomy 188-41-51	WB1 70501	POTTER A E Remote Sensing Of Planetary Surfaces 198 41 40	WB1 70519	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
Interdisciplinary Space Science Research 188 48-51	WB1-70514	POWERS A G Variable Cycle Engine Technology 535 02 12	WB1 70168	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
OGILVIE K W Particles and Particle/Field Interactions 170 36-55	WB1-70492	PRESELL, L L Aerodynamic Theory/Experimental Integration 505 31 41	WB1 70007	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
P					
PAGE M A Shuttle Derived Vehicle Technology Requirements 540 03 19	WB1 70285	PRESTON R A Mars Data Analysis - Astronomy 155-41 80	WB1 70482	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAGE W A Atmospheric Processes Experiments and Systems 147 10 03	WB1 70356	PRICE H W Multi Spectral Detectors and Sensors 506-54 46	WB1 70211	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAINTER W D Flight Test of the Tilt Rotor Research Aircraft 532 04 14	WB1 70138	PRICE, R D NASA End to End Data System (NEEDS) Phase 2 506 61 56	WB1 70262	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PARNELL T A Particle Astrophysics 188 46 56	WB1 70508	PRIEM R J Liquid-Chemical Propulsion Technology 506-52 12	WB1 70180	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAWLIK E Y Advanced Energy Technology 506 55 15	WB1 70228	PROBST H B Metallic/Ceramic Materials 505-33 12	WB1 70031	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PERRY T W Improved Measurement and Calibration Techniques for Stratospheric Trace Species 146-60 01	WB1 70348	Q			
PETERS P N Solid State Research Superconducting Circuitry 506-54-69	WB1-70218	RAMATY R Theoretical High Energy Astrophysics 389-46 03	WB1 70563	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PETERSON, V L Computational Methods and Applications in Fluid Dynamics 505-31 11	WB1 70001	RAMLER, J R Communications Satellite Applications Systems 643-10 02	WB1 70378	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PETRASH D A Combustion and Emissions Reduction Research 505-32 32	WB1 70023	30/20 GHz Wideband System Definition 650-20-16	WB1-70384	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
R					
PAGE M A Shuttle Derived Vehicle Technology Requirements 540 03 19	WB1 70285	RANEY J P General Aviation Propeller Noise Reduction 505-41 43	WB1 70075	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAGE W A Atmospheric Processes Experiments and Systems 147 10 03	WB1 70356	RANSFORD G A Planetary Synthesis 153-06-70	WB1-70451	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAINTER W D Flight Test of the Tilt Rotor Research Aircraft 532 04 14	WB1 70138	RAPER J L Radiation Budget and Aerosol Studies 146 10-06	WB1-70326	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PARNELL T A Particle Astrophysics 188 46 56	WB1 70508	Loads Aeroelasticity and Structural Dynamics 505 33-53	WB1 70040	REINHARDT V S Precision Time and Frequency Sources 310 10-42	WB1 70574
PAWLIK E Y Advanced Energy Technology 506 55 15	WB1 70228	S			
PERRY T W Improved Measurement and Calibration Techniques for Stratospheric Trace Species 146-60 01	WB1 70348	QUATTROCHI, D Surface Mine Rehabilitation Inventory and Monitoring 677 21 20	WB1-70411	SADIN S R Space Systems and Planning Analysis 540 04 10	WB1 70286
PETERS P N Solid State Research Superconducting Circuitry 506-54-69	WB1-70218	R	WB1 70040	SAFFREN, M M Electrostatic Control & Manipulation of Materials for Containerless Processing 179 20 56	WB1-70368
PETERSON, V L Computational Methods and Applications in Fluid Dynamics 505-31 11	WB1 70001	SANTARPI, D E High Speed Data Transfer S/K-Band Components and Techniques 506-61 26	WB1 70252	SAFFREN, M M Electrostatic Control & Manipulation of Materials for Containerless Processing 179 20 56	WB1-70368
PETRASH D A Combustion and Emissions Reduction Research 505-32 32	WB1 70023	SAUNDERS N T Energy Efficient Engine Project 535-01 12	WB1 70167	SAFFREN, M M Electrostatic Control & Manipulation of Materials for Containerless Processing 179 20 56	WB1-70368
Q					
PAGE M A Shuttle Derived Vehicle Technology Requirements 540 03 19	WB1 70285	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PAGE W A Atmospheric Processes Experiments and Systems 147 10 03	WB1 70356	SAWIN, C F Crew Health Maintenance 199-10 30	WB1-70536	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PAINTER W D Flight Test of the Tilt Rotor Research Aircraft 532 04 14	WB1 70138	SCHWARTZ J J Network Systems Technology Development 310-20-33	WB1 70580	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PARNELL T A Particle Astrophysics 188 46 56	WB1 70508	SHAUGHNESSY J D General Aviation Single Pilot IFR Systems 505 41-73	WB1-70079	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PAWLIK E Y Advanced Energy Technology 506 55 15	WB1 70228	Advanced Spacecraft Pointing and Control Systems 506-54-93	WB1-70224	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PERRY T W Improved Measurement and Calibration Techniques for Stratospheric Trace Species 146-60 01	WB1 70348	SHERMAN A Sensor Cooling System 506-61 46	WB1 70259	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PETERS P N Solid State Research Superconducting Circuitry 506-54-69	WB1-70218	SHUMATE W H Operational Laboratory Support 199-10 10	WB1-70534	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PETERSON, V L Computational Methods and Applications in Fluid Dynamics 505-31 11	WB1 70001	SHURE, L I Power Generation Concepts and Applications 778-46 12	WB1 70306	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440
PETRASH D A Combustion and Emissions Reduction Research 505-32 32	WB1 70023	SIDWELL, L B Space Calibration of Solar Cells 542-03-20	WB1-70292	SAUNDERS R S Planetary Geology 151 01 70	WB1-70440

SIEMERS P M	SWIFT C T
Shuttle Entry Air Data System (SEADS)	Microwave Remote Sensing for Ice Processes Research
506 63 32	146 40-06
SIMPSON J	Advanced Ocean Sensor Systems Development
Severe Storms and Local Weather Research	146 40 13
146 50 02	W81 70340
SISK T R	SYDNOR R L
Aeronautics Flight Experiments	Frequency and Timing Research
505 31 44	310 10-62
Knowledge of High Altitude Atmospheric Processes	W81 70577
505 44 14	5ZALAI K J
Aerodynamics of Ground Vehicles	Aircraft Controls Flight Systems Concepts
141 20-11	505 34-34
W81 70316	W81 70052
SLIFER L W	SZIRIMAY, S Z
Advanced Power System Technology	Precision Pointing and Control Technology (PPACT)
506 55-76	Development
W81 70242	506 54-95
SMITH D E	W81 70225
Global Earth Dynamics and Structure	
676 30-01	
Geopotential Field Models	T
676 40-01	
Advanced Flight Experiments	TAPSCOTT R J
Angle of-Attack	General Aviation System Technology Studies
533 02-34	530 01 13
WB1 70152	W81-70126
SMITH H J	TAUSWORTHIE R C
Advanced Flight Experiments	Network Data Processing Development
F 14 High	310 40 72
WB1 70403	W81-70595
TAYLOR H A	TAYLOR P T
Extended Atmospheres	Crustal Modeling Using Satellite Potential Field Data
154-80 80	677 45 01
WB1 70404	W81-70429
TELES, J	TELES, J
Attitude/Orbit Systems Technology	Attitude/Orbit Systems Technology
310-10 26	W81 70573
TENNEY, D R	TENNEY, D R
Composites for Advanced Space Systems	Composites for Advanced Space Systems
506 53 23	506 53 23
WB1 70192	W81 70192
TERRILE R J	TERRILE R J
Planetary Infrared Imaging	Planetary Infrared Imaging
196 41 77	196 41 77
WB1 70527	W81 70527
TETRICK R V	TETRICK R V
Mission Operations Technology	Mission Operations Technology
310 40 45	W81 70592
THALLER L H	THALLER L H
Electrochemical Energy Conversion and Storage	Electrochemical Energy Conversion and Storage
506 55 52	506 55 52
WB1 70236	W81 70236
THOMAS D T	THOMAS D T
NASA End-to-End Data System (NEEDS) Data Base	NASA End-to-End Data System (NEEDS) Data Base
Management/Archival Mass Memory	Management/Archival Mass Memory
506 61 59	506 61 59
WB1 70263	W81-70263
THOMAS H	THOMAS H
Petrologic and Geophysical Studies of the Source of Long	Petrologic and Geophysical Studies of the Source of Long
Wavelength Crustal Magnetic Anomalies	Wavelength Crustal Magnetic Anomalies
677 45 03	677 45 03
WB1 70430	W81-70430
THOMPSON D E	THOMPSON D E
MDAP Geology	MDAP Geology
155-50 01	155-50 01
WB1 70485	W81-70485
THOMPSON L L	THOMPSON L L
Phase B Studies	Landsat Solid State Sensor (LSS)
677 29 09	677 29 09
WB1-70417	W81-70417
THOMSON R G	THOMSON R G
Multispectral Linear Arrays for the Short Wave Infrared	Multispectral Linear Arrays for the Short Wave Infrared
(MLA/SWIR)	(MLA/SWIR)
677-77 01	677-77 01
WB1 70438	W81 70438
THOMSON R G	THOMSON R G
General Aviation Crash Dynamics	General Aviation Crash Dynamics
505 41 33	505 41 33
WB1 70074	W81 70074
THORNTON C L	THORNTON C L
Radio Metric Analysis	Radio Metric Analysis
Instrumentation Development	Instrumentation Development
310-10 60	310-10 60
WB1 70575	W81 70575
TOLSON R H	TOLSON R H
Stratospheric Theoretical Studies and Science Definition	Stratospheric Theoretical Studies and Science Definition
Activities	Activities
147 30 01	147 30 01
WB1 70361	W81-70361
TOON, O B	TOON, O B
Theoretical Studies of the Upper Tropospheric Aerosol	Theoretical Studies of the Upper Tropospheric Aerosol
Layer and Sahara Dust	Layer and Sahara Dust
146-20 23	146-20 23
WB1 70329	W81 70329
TRAINOR J H	TRAINOR J H
Particle Accelerator Facility Maintenance and Operation	Particle Accelerator Facility Maintenance and Operation
of a Calibration Facility for Magnetospheric and	of a Calibration Facility for Magnetospheric and
Solar-Terrestrial Experiments	Solar-Terrestrial Experiments
170-36 57	170-36 57
WB1 70494	W81 70494
TRAJMAR S	TRAJMAR S
Aeronomy Energy Deposition	Aeronomy Energy Deposition
154-70 80	154-70 80
WB1 70470	W81 70470
TROMBKA J I	TROMBKA J I
X Ray Gamma Ray and Neutron Gamma Ray Methods	X Ray Gamma Ray and Neutron Gamma Ray Methods
for Planetary Exploration	for Planetary Exploration
157-03 50	157-03 50
WB1-70489	W81-70489
TRUSZKOWSKI W	TRUSZKOWSKI W
Human-To Machine Interface Technology	Human-To Machine Interface Technology
310-40-37	310-40-37
WB1 70591	W81 70591
U	U
URBAN, E W	URBAN, E W
Superconducting Gravity Gradiometer	Superconducting Gravity Gradiometer
676-59 33	676-59 33
WB1 70406	W81 70406
VALERINO, M F	VALERINO, M F
QPLT Systems Technology	QPLT Systems Technology
532-02-12	532-02-12
WB1 70135	W81 70135
VANIMAN J L	VANIMAN J L
Thermal Control System Technology	Thermal Control System Technology
506-53-39	506-53-39
WB1 70198	W81 70198
VAUGHAN W W	VAUGHAN W W
Global Weather Research	Global Weather Research
146-30-02	146-30-02
WB1 70331	W81 70331
Severe Storms and Local Weather Research	Severe Storms and Local Weather Research
146-50 02	146-50 02
WB1 70345	W81 70345
VETTE J I	VETTE J I
Data Reproduction in Support of the Mars Data Analysis	Data Reproduction in Support of the Mars Data Analysis
Program	Program
155 50-01	155 50-01
WB1 70484	W81 70484
VILLONE P	VILLONE P
Cost Analysis of Space Flight Systems within the Office	Cost Analysis of Space Flight Systems within the Office
for Space and Terrestrial Applications	for Space and Terrestrial Applications
146-90 03	146-90 03
WB1 70351	W81 70351
VONTIESHENHAUSEN G	VONTIESHENHAUSEN G
Space Applications of Automation Robotics and Machine	Space Applications of Automation Robotics and Machine
Intelligence Systems (ARAMIS)	Intelligence Systems (ARAMIS)
540 02-19	540 02-19
WB1 70283	W81 70283
W	W
WALIGORA J M	WALIGORA J M
Systems Habitability Verification	Systems Habitability Verification
199 10-41	199 10-41
WB1 70537	W81 70537
WALL W A	WALL W A
Commercial Prototype Fusion-Welding System	Commercial Prototype Fusion-Welding System
(Computer Controlled/Closed Circuit Television Arc	(Computer Controlled/Closed Circuit Television Arc
Guidance)	Guidance)
141-95 01	141-95 01
WB1 70318	W81 70318
WANG T G	WANG T G
Development of a Shuttle Flight Experiment Drop	Development of a Shuttle Flight Experiment Drop
Dynamics Module	Dynamics Module
542 03 01	542 03 01
WB1 70289	W81 70289
Advanced Containerless Processing Technology	Advanced Containerless Processing Technology
179-20 55	179-20 55
WB1 70367	W81 70367
Fusion Target Technology Study	Fusion Target Technology Study
179 20-57	179 20-57
WB1 70369	W81 70369
WARD W R	WARD W R
Planetary Dynamics	Planetary Dynamics
153 05-70	153 05-70
WB1 70450	W81 70450
WARNER J L	WARNER J L
Instrument Development for Spaceflight Experiments	Instrument Development for Spaceflight Experiments
157 03-40	157 03-40
WB1 70488	W81 70488
WASILEWSKI P	WASILEWSKI P
Experimental Magnetism	Experimental Magnetism
153 08 50	153 08 50
WB1 70454	W81 70454
WATSON R T	WATSON R T
Photochemical Modeling of Trace Species in the	Photochemical Modeling of Trace Species in the
Stratosphere and Mesosphere	Stratosphere and Mesosphere
147 30-01	147 30-01
WB1 70362	W81 70362
WEAVER E A	WEAVER E A
Aviation Operations Safety Technology	Aviation Operations Safety Technology
Technology	Technology
505 44-29	505 44-29
WB1 70113	W81 70113
WEBER R J	WEBER R J
Advanced Engine System Concepts	Advanced Engine System Concepts
505 32 92	505 32 92
WB1 70029	W81 70029
Propulsion Systems for Small Transports	Propulsion Systems for Small Transports
530 04 12	530 04 12
WB1 70129	W81 70129
Advanced Propulsion System Concepts	Advanced Propulsion System Concepts
530 05-12	530 05-12
WB1 70131	W81 70131
SCR Propulsion Technology	SCR Propulsion Technology
533 01-32	533 01-32
WB1 70146	W81 70146
WEBER, W J	WEBER, W J
Earth Satellite Communication Antenna Development	Earth Satellite Communication Antenna Development
541 02 15	541 02 15
WB1 70288	W81 70288
Technical Consultation Services	Technical Consultation Services
643 10 01	643 10 01
WB1 70375	W81 70375
Communication Satellite Application Systems	Communication Satellite Application Systems
643 10 02	643 10 02
WB1-70377	W81-70377
Systems Coordination Support	Systems Coordination Support
643 10-03	643 10-03
WB1 70379	W81 70379
WEEKS E L	WEEKS E L
ACIP (Aerodynamic Coefficient Identification	ACIP (Aerodynamic Coefficient Identification
Package)	Package)
506-63 27	506-63 27
WB1 70270	W81 70270
WEISSKOPF M C	WEISSKOPF M C
X Ray Astronomy Time Variability and Polarimetry	X Ray Astronomy Time Variability and Polarimetry
188-46 59	188-46 59
WB1 70512	W81 70512
WELLMAN, J	WELLMAN, J
Remote Sensing Systems	Remote Sensing Systems
506 61 35	506 61 35
WB1 70255	W81 70255
WENGER N C	WENGER N C
Propulsion Instrumentation Research	Propulsion Instrumentation Research
505-32 82	505-32 82
WB1 70028	W81 70028
WHITCOMB R T	WHITCOMB R T
Configuration Aerodynamics	Configuration Aerodynamics
505-31-43	505-31-43
WB1 70008	W81 70008
WHITING E E	WHITING E E
CFD Training Program	CFD Training Program
505-36-20	505-36-20
WB1 70065	W81 70065
WHITTEN, R C	WHITTEN, R C
Planetary Clouds Particulates and Ices Clouds of	Planetary Clouds Particulates and Ices Clouds of
Venus	Venus
154 30 80	154 30 80
WB1 70462	W81 70462

Aeronomy of Planetary Atmospheres Chemistry
154-75-80 W81 70472

WILCK H C
RFI Systems Technology
310-30-69 W81 70588

WILLIAMS J R
Commercialization an Orbital Tube Flaring System
141-95 01 W81 70319

WILLIAMS R J
Refining of Nonterrestrial Materials
506-53-17 W81 70191

Planetary Materials Laboratory and Analytical Studies
152 02 40 W81 70443

WILLIS E A
Advanced General Aviation Propulsion Research
505-41-22 W81 70073

WILLIS, S
Extreme Ultraviolet Explorer
685-20-06 W81 70565

WILLOH R G
Engine Dynamics and Controls Research
505-32-62 W81 70026

WILSON D
Satellite Communications Technology
310-20 38 W81 70581

WILSON D E
Alaska Wetlands Delineation Program
677-21 22 W81 70412

WILSON J C
Rotorcraft Aerodynamics Scale Modeling
505-42 23 W81 70084

WINKELSTEIN R A
Telemetry Technology Development
310-20-87 W81 70586

WITCOFSKI, R D
Post Spill Liquid Hydrogen Behavior
505-31-70 W81-70014

WOLFF R S
Extended Atmospheres
154-80 80 W81 70475

WOOLLEY C T
Intelligent Systems Research
506-54-83 W81 70222

WU S T
Integration of VIS-IR NW Data
677-21-06 W81 70410

X

XENAKIS, G
Rotorcraft Operating Systems Technology
532 01 11 W81-70133

Y

YOUNG J P
Payload Environments and Dynamics
506 53-66 W81-70205

YOUNG L S
Development of Shuttle Infrared Telescope Facility
(SIRTF)
358 41 06 W81-70551

YOUNG, R E
Dynamics of Planetary Atmospheres
154-20-80 W81-70460

YUEN J H
Network Productivity Research
310 40-73 W81-70596

Z

ZARETSKY E V
Helicopter Transmission Technology
511 58-12 W81-70122

ZOBRIST A L
Automated Mosaicking for Geocoded Data Bases
656 33-01 W81-70398

ZOUTENDYK J A
Infrared Detector Materials Preparation
179 80-10 W81-70372

ZUK J
Low Speed Aircraft Systems Studies
530 02-11 W81-70127

ZUREK R W
Dynamic Radiative Interaction
154 20-80 W81-70461

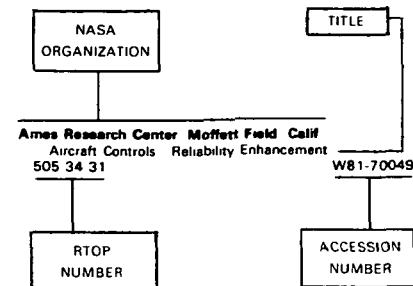
ZYGIELBAUM A I
Arrayed Network Technology
310 40 74 W81-70597

RESPONSIBLE NASA ORGANIZATION INDEX

FISCAL YEAR 1981

RTOP Summary

Typical Responsible NASA Organization Index Listing



Listings in this index are arranged alphabetically by Responsible NASA Organization. The title of the RTOP provides the user with a brief description of the subject matter. The accession number denotes the number by which the citation and the technical summary can be located within the Summary Section. The titles are arranged under each Responsible NASA Organization in ascending accession number order.

A

Ames Research Center Moffett Field Calif	
Computational Methods and Applications in Fluid Dynamics	
505 31 11	W81 70001
Turbulence and Modeling	
505 31 21	W81 70003
Airfoil and Wing Development	
505-31-31	W81 70005
Aerodynamic Theory/Experimental Integration	
505 31 41	W81 70007
Aerodynamic Test Methods and Instrumentation	
505 31 51	W81 70010
Noise Reduction Technology for Short Haul Aircraft	
505-32 01	W81 70016
Fatigue Damage and Environmental Effects in Metals and Composites	
505 33 21	W81 70033
Fire Resistant Materials	
505 33 31	W81 70036
Navigation and Guidance Short Range Operations	
505 34-11	W81-70047
Aircraft Controls Reliability Enhancement	
505 34 31	W81 70049
Flight Management Systems	
505-35 21	W81 70056
Simulation Technology for Aeronautics	
505 35 31	W81-70059
Funds for Independent Research (Aeronautics)	
505 36 11	W81-70061
Aeronautics Graduate Research Program FY 1981	
505 36 21	W81 70066
General Aviation Aerodynamic Performance Technology	
505-41 11	W81-70070
Rotocraft Aeroelasticity and Structural Dynamics	
505 42 11	W81-70081
Rotocraft Aerodynamic Performance Dynamics and Handling Qualities	
505-42 21	W81-70083
Integrated Avionic Control Systems for Rotocraft	
505 42 31	W81-70085
Heavy-Lift/Short Haul Hybrid Airship Technology	
505 42 51	W81 70086
Advanced V/StOL Aircraft Aerodynamics and Flight Dynamics Research	
505-42 71	W81-70088
Flight Vehicle Dynamics	
505 43 11	W81-70090
High Performance Aircraft Airframe Propulsion Integration	
505-43 21	W81 70093

Interagency and Industrial Assistance and Testing	
505-43 31	W81-70096
Aviation Safety Technology Operational Problems and Fireworthiness	
505-44-21	W81-70107
Aircraft Systems Operational Safety and Efficiency Improvement	
505-44 31	W81 70114
Advanced Guidance and Control Systems Validation Technology	
512-54-11	W81 70124
Low Speed Aircraft Systems Studies	
530-02 11	W81-70127
General Aviation Advanced Avionics Systems	
531-01 11	W81 70132
Rotocraft Operating Systems Technology	
532-01 11	W81 70133
Quiet Propulsive Lift Technology Experiments Aircraft Performance and Operating Systems Research	
532 02-11	W81-70134
Advanced Rotor Systems Technology/RSSA Operations	
532-03 11	W81 70136
Tilt Rotor Research Aircraft Flight Investigations	
532-04-11	W81 70137
V/StOL Systems Technology	
532 05-11	W81-70139
Fuel Tank Sealants	
533 01 11	W81 70143
Energy Efficient Transport Wind Tunnel Testing	
534-02 11	W81 70159
Numerical Aerodynamic Simulator (NAS Project)	
536 01-11	W81 70172
Computational and Experimental Aerothermodynamics	
506 51-11	W81-70173
Planetary Probe Aerothermodynamic Technology	
506-51 21	W81 70175
OEX Flight Data Analysis	
506 51-31	W81 70177
Surface Physics and Computational Chemistry	
506 53-11	W81-70188
Thermal Protection Systems Materials and Systems Evaluation	
506-53 31	W81 70195
Photophysics and Laser Diagnostics	
506 54-41	W81 70207
Funds for Independent Research (Space)	
506 56-11	W81 70244
Infrared Detectors Far IR Sensors	
506 61-31	W81 70253
Space Shuttle Configuration and Aerothermodynamics	
506 63-11	W81 70268
Infrared Imagery of Shuttle	
506 63-35	W81 70274
OEX Thermal Protection Experiments	
506 63-36	W81 70275
Space System Studies Information and Spacecraft Systems	
540 02 11	W81 70280
Remote Sensing of Subsurface Drain Malfunctions	
141 20 21	W81 70317
Aerosol Climatic Effects Special Study	
146 10 04	W81 70325
Theoretical Studies of the Upper Tropospheric Aerosol Layer and Saharan Dust	
146 20 23	W81 70329
Atmospheric Processes Experiments and Systems	
147 10 03	W81 70356
Quantitative Infrared Spectroscopy of Minor Constituents of the Earth's Stratosphere	
147 20 03	W81 70359
Stratospheric Research	
147 30-02	W81 70363
Alaska Wetlands Delineation Program	
677 21 22	W81 70412
Remotely Sensed Electromagnetic Characteristics of Snow and Soil Moisture	
677 22 12	W81 70413
Planetary Aeolian Processes on Planets	
151 01 60	W81 70439
Theoretical Studies of Planetary Bodies	
151 02 60	W81 70441
Formation Evolution and Stability of Proto Stellar Disks	
153-01 60	W81 70446
NASA Ames Research Center Vertical Gun Facility	
153 08 60	W81-70455
Planetary Atmospheric Composition and Structure	
154 10 80	W81 70457
Dynamics of Planetary Atmospheres	
154-20 80	W81 70460
Planetary Clouds Particulates and Ices Clouds of Venus	
154-30 80	W81-70462
Aeronomy of Planetary Atmospheres Chemistry	
154-75 80	W81 70472

Planetary Atmospheres Data Analysis	
155 04 80	W81-70479
Magnetospheric Physics Particles and Particle/Field Interaction	
170-36 55	W81 70491
Theoretical Studies of Galaxies Active Galactic Nuclei and Quasi Stellar Objects	
188-41 51	W81 70503
Theoretical Infrared and Radio Astrophysics	
188-41 55	W81 70506
Detection of Other Planetary Systems	
196-41 68	W81-70524
Development of Shuttle Infrared Telescope Facility (SIRTF)	
358-41-06	W81 70551
Pioneer 6 11 Plasma Data Analysis	
385 36 01	W81 70556

D

Hugh L. Dryden Flight Research Center Edwards Calif	
Aeronautics Flight Experiments	
505-31 44	W81 70009
Flight Research Instrumentation Development	
505-31-54	W81 70012
Flight Loads and Aeroelasticity	
505-33-54	W81-70041
Aircraft Controls Flight Systems Concepts	
505-34-34	W81 70052
Human Factors Flight Research with High Performance Aircraft and RPVs	
505-35 24	W81 70058
Funds for Independent Research	
505-36 14	W81 70064
University Research in Flight Testing Techniques	
505-36 24	W81-70069
AV 8A V/StOL Flight Experiments	
505-42 74	W81-70089
Flight Dynamics and Handling Qualities	
505-43 14	W81 70092
Interagency Assistance and Testing	
505 43 34	W81 70098
Remotely Piloted Research Aircraft Technology	
505-43 44	W81 70099
Aircraft Operational Support	
505-43-54	W81 70100
Knowledge of High Altitude Atmospheric Processes	
505-44-14	W81-70103
Advanced Guidance and Control Flight Systems Experiments	
512 54-14	W81 70125
Flight Test of the Tilt Rotor Research Aircraft	
532 04-14	W81 70138
SCR Materials and Structures Flight Research	
533-01-14	W81-70145
Advanced Flight Experiments Advanced Fighter Technology Integration/F111 (AFTI/F-111)	
533 02-14	W81-70150
High Performance Aircraft Flight Test Support	
533 02 24	W81 70151
Advanced Flight Experiments F 14 High Angle of Attack	
533 02-34	W81-70152
Integrated Research Aircraft Control Technology	
533 02-44	W81 70153
AFTI/F 16	
533 02 64	W81 70154
Laminar Flow Control (Leading Edge Glove) Flight Research	
534 01 14	W81 70158
Energy Efficient Transport Flight Research	
534 02-14	W81-70161
Advanced Turboprop Flight Research	
535-03 14	W81-70171
Space Shuttle Aerodynamic Experiments	
506 51 34	W81 70179
Loads Dynamics and Aeroelasticity	
506 53-64	W81 70203
Aerodynamics of Ground Vehicles	
141 20-11	W81 70316

G

Goddard Inst for Space Studies New York	
Numerical Climate Modeling	
146 10 02	W81-70323
Stratospheric Modeling	
147 30-02	W81 70364
Goddard Space Flight Center, Greenbelt Md	
Payload Environments and Dynamics	
508 53-66	W81 70205
Multi-Spectral Detectors and Sensors	
506 54 46	W81 70211

Signal Detection and Processing	Filters and Receivers	Cosmic Chemistry	Aeronomy	Comets	Grains	Operations Support	Computing Technology
506 54-56	W81 70213	154-75-80		W81-70471	310 40 26	W81-70590	
Autonomous Process Control Technology for Earth Orbital Missions		Extended Atmospheres		W81-70474	Human To Machine Interface Technology	W81 70591	
506 54-76	W81-70221	154 80 80		W81-70474	310-40 37	Mission Operations Technology	
Advanced Power System Technology		Planetary Atmosphere Experiment Development		W81-70477	310-40 45	W81-70592	
506 55 76	W81 70242	154 90-80		W81 70478	Image Processing Technology	W81 70593	
Fund for Independent Research		Mars Data Analysis		W81 70478	310-40 46	Systems Management Technology	
506 56 16	W81 70247	155 04 80		W81 70478	310-40 49	W81 70594	
High Speed Data Transfer S/K Band Components and Techniques		Data Reproduction in Support of the Mars Data Analysis Program		W81 70484			
506-61-26	W81 70252	155 50-01		W81 70484			
Sensor Systems		X Ray Gamma-Ray and Neutron Gamma Ray Methods for Planetary Exploration		W81 70489			
506-61-36	W81 70256	157-03 50		W81 70489			
Sensor Cooling System		Particles and Particle/Field Interactions		W81 70492			
506 61 46	W81 70259	170 36 55		W81-70492			
NASA End to End Data System (NEEDS) Phase 2		Particle and Particle/Photon Interactions		W81-70492			
506 61 56	W81 70262	170 36 56		W81-70493			
Ground Data Processing Technology Options Assessment for Missions of the 1985 1990 Time Frame		Particle Accelerator Facility Maintenance and Operation of a Calibration Facility for Magnetospheric and Solar Terrestrial Experiments		W81 70494			
540 01 16	W81 70279	170 36-57		W81 70494			
Climate Research		Development of Solar Spacelab Experiment and Hardware		W81 70496			
146-10 03	W81 70324	170 38-51		W81 70496			
Global Tropospheric Models Monitoring		Ground Based Observations of the Sun		W81-70496			
146-20-08	W81 70327	170-38-52		W81 70497			
Global Weather Research		Experiment Development Laboratory and Theoretical Solar Physics		W81 70497			
146-30 02	W81 70330	170-38-53		W81-70499			
Remote Sensing of Air Sea Interactions Phenomena		Origins of Plasma in the Earth's Neighborhood (OPEN)		W81-70499			
146-40-05	W81 70335	171 03 00		W81-70500			
Ocean Circulation and Topography		UV and Optical Astronomy		W81-70500			
146 40 07	W81 70337	188 41 51		W81-70502			
Coastal and Estuarine Dynamic Processes Research		Fiber Optically Mosaiced Large Area Image Sensors		W81-70502			
146 40 15	W81 70342	188 41-54		W81 70504			
Severe Storms and Local Weather Research		Infrared and Radio Astronomy		W81 70504			
146 50 02	W81 70344	188 41-55		W81 70505			
Ozone Data Reduction and Analysis and Solar UV Variability		Particle Astrophysics and Shuttle Experiment Definition		W81 70505			
146-60 01	W81 70346	188 46-56		W81 70509			
Cost Analysis of Space Flight Systems within the Office for Space and Terrestrial Applications		Gamma Ray Astronomy		W81 70509			
146-90 03	W81 70351	188 46-57		W81 70510			
Upper Atmosphere Research - Field Measurements		X Ray Astronomy		W81 70510			
147-10 01	W81 70352	188 46 59		W81 70513			
Upper Atmosphere Research Laboratory Measurements		Advanced Technological Development General Signal and Data Processing Electronics Solid State Detectors		W81 70513			
147 20-01	W81 70357	188-78 51		W81 70516			
Upper Atmosphere Research Theoretical Studies		Ground Based Infrared Astronomy		W81 70516			
147-30 01	W81 70360	196 41 50		W81-70520			
Upper Atmosphere Research Satellites (UARS) Definition Study		Radio and Radar Planetary Studies		W81-70520			
147-40 01	W81 70365	196 41 51		W81-70521			
OSTA/ADS Data Systems Standards and Guidelines Program		Imaging Studies of Comets		W81-70522			
656-13 10	W81 70391	196 41 52		W81-70522			
Full Scale Applications Data Service (ADS) Planning Studies		Advanced Infrared Astronomy and Laboratory Astrophysics		W81-70522			
656-13 20	W81 70392	196 41-54		W81-70523			
Applications Data Service (ADS) Atmospheric Pilot System		Atmosphere Ionosphere-Magnetosphere Interactions		W81-70523			
656-13 30	W81 70393	385 36-01		W81 70554			
Oceanic Data Utilization System Study		Data Analysis - Space Plasma Physics		W81 70554			
656-13-60	W81 70395	385 36-02		W81 70557			
Regional Crustal Deformation Modeling		Energetic Particles and Plasmas in the Magnetospheres of Jupiter and Saturn		W81 70557			
676 10-10	W81 70402	385-36-04		W81 70558			
Global Earth Dynamics and Structure		Solar Physics Data Analysis and Operations		W81 70558			
676 30-01	W81 70403	385 38 01		W81 70559			
Geopotential Field Models		Data Analysis Astronomy		W81 70559			
676 40-01	W81 70404	389-41 01		W81 70561			
Advanced Geodynamics Studies		High Energy Astrophysics Data Analysis		W81 70561			
676-59 30	W81 70405	389 46 01		W81-70562			
Laser/VLBI Propagation Medium Analysis		Theoretical High Energy Astrophysics		W81-70562			
676-59 35	W81 70407	389 46 03		W81-70563			
Gravity Field Survey Mission (GRAVSET) Phase B Studies		X Ray Astronomy Data Analysis		W81-70563			
677-29-04	W81 70415	389 46-04		W81 70564			
Demonstration Flight System and Operational Land Observing System (OLOS)		Extreme Ultraviolet Explorer		W81 70564			
677 29 06	W81 70416	685 20-06		W81 70565			
Phase B Studies Landsat Solid State Sensor (LS3)		Cosmic Background Explorer (COBE)		W81 70565			
677 29-09	W81 70417	685-20 08		W81-70566			
Geobotanical Test Site Investigations		X-Ray Timing Explorer (XTE)		W81-70566			
677-42 01	W81 70424	685-20 11		W81-70567			
Crustal Modeling Using Satellite Potential Field Data		Soundings Rockets Magnetospheric Physics Experiments		W81-70567			
677-45-01	W81 70429	828 11 36		W81 70568			
Petrologic and Geophysical Studies of the Source of Long Wavelength Crustal Magnetic Anomalies		Soundings Rockets Experiment		W81 70568			
677-45 03	W81 70430	828 11 38		W81 70569			
Magnet Correlative Studies		Soundings Rocket Experiments (High Energy Astrophysics)		W81 70569			
677-45 04	W81 70431	879 11 46		W81-70570			
Multispectral Linear Arrays for the Short Wave Infrared (MLA/SWIR)		Sounding Rockets Experiments (Astronomy)		W81-70570			
677-77 01	W81 70438	879-11 41		W81-70571			
Experimental Magnetism		Software Engineering Technology		W81-70571			
153-08 50	W81 70454	310 10 23		W81-70572			
Planetary Atmospheric Dynamics		Attitude/Orbit Systems Technology		W81-70572			
154-20-80	W81 70459	310 10 26		W81 70573			
Atomic & Molecular Properties of Planetary Atmospheric Constituents		Precision Time and Frequency Sources		W81 70573			
154 50-80	W81 70465	310 10 42		W81 70574			
Planetary Aeronomy Theory and Analysis		Network Timing and Synchronization Technology		W81 70574			
154-60-80	W81 70467	310 20-27		W81 70579			
Ultraviolet Spectroscopy of Planetary Atoms and Molecules		Network Systems Technology Development		W81 70579			
154-70 80	W81 70469	310 20-33		W81-70580			
		Satellite Communications Technology		W81-70581			
		Technology for TDRSS User Spacecraft		W81 70582			
		310 20 46		W81 70582			

J

Jet Propulsion Laboratory Pasadena Calif

Basic Noise Research	
505 32 05	W81-70019
Microwave Technology Development for Atmospheric Turbulence Studies	
505-44 15	W81-70104
Aviation Safety Technology Applied Fluid Mechanics	
505-44 25	W81 70110
High Energy Chemical Propulsion Technology for Planetary Spacecraft	
506-52 25	W81 70183
Advanced Chemical Propulsion Concepts for Planetary Spacecraft	
506 52 35	W81 70185
Fundamentals of Mechanical Behavior of Composites Matrices	
506 53 15	W81-70190
Effects of Space Environment on Composites	
506 53 25	W81-70193
Optimization of Structural Systems	
506-53 55	W81 70201
Space Vehicle Dynamics Methodology	
506-53 65	W81 70204
Quantum Electronics Sources	
506-54 45	W81 70210
Data Transmission and Processing Research	
506-54 55	W81 70212
Fundamental Electronics	
506 54 65	W81 70217
Automation of Space Mission Uplink Process Control	
506 54 75	W81-70220
Robotics/Machine Intelligence Automated Systems	
506 54 85	W81-70223
Precision Pointing and Control Technology (PPACT) Development	
506 54 95	W81 70225
Advanced Energy Technology	
506 55 15	W81 70228
MPD Thruster System Technology	
506-55 35	W81 70232
Planetary Solar Array Research and Technology	
506-55 45	W81 70235
Advanced Nickel Cadmium and Lithium Batteries	
506-55 55	W81 70237
Thermal Electric and Thermionic Energy Conversion Technology	
506-55 65	W81-70239
Planetary Power Systems R & T	
506 55 75	W81 70241
High Speed Data Transfer X/S Band Components	
506 61 25	W81 70251
Remote Sensing Systems	
506 61 35	W81 70255
NASA End-to-End Data System	
506-61 55	W81 70261
Planetary & Solar Spacecraft Systems Automated Optical Navigation	
506-62 55	W81 70265
Space Mission Uplink Process Control Architecture	
540-01 15	W81 70278
Far Outer Planets Spacecraft Technology Definition	
540 02 15	W81-70282
Earth Satellite Communication Antenna Development	
541 02 15	W81 70288
Development of a Shuttle Flight Experiment Drop Dynamics Module	
542 03-01	W81-70289
Spacelab 2 Superfluid Helium Experiment	
542 03 13	W81 70291
Space Calibration of Solar Cells	
542 03 20	W81 70292
Studies in Bioenergy	
776 91 35	W81 70301
Energy Planning Support at JPL	
778 45 35	W81 70305
Validation of Stirling Lab Engine	
778-46 35	W81 70308
Advanced Coal Processing Concepts	
778-47 15	W81-70309
Concepts for Improved Ground Transportation Systems	
778 48 15	W81 70311
Industrial Conservation Cogeneration and Utilization of Alternative Fuels	
778-49 15	W81-70313
Utility Power Supply and Load Management	
778 50 15	W81-70314
Seasat Data Utilization Project	
146-01-00	W81 70322
Ocean Wave Height Determination with the Synthetic Aperture Radar	
146-40 05	W81-70334

RESPONSIBLE NASA ORGANIZATION INDEX

Langley Research Center, Hampton, Va			
Scatterometer Data Analysis	W81-70338	Aeronomy	Chemistry
146-40-12		154-75 80	W81 70473
Stratospheric Research Field Measurements Program		Extended Atmospheres	
147-10-02	W81-70354	154 80 80	W81 70475
Chemical Kinetics		Atmospheric Experiment Development	
147-20-01	W81-70358	154 90 80	W81 70476
Photochemical Modeling of Trace Species in the Stratosphere and Mesosphere		Mars Data Analysis Studies	W81-70481
147-30-01	W81-70362	155-20 70	
Advanced Containerless Processing Technology		Mars Data Analysis	Astronomy
179-20-55	W81-70367	155-41 80	W81-70482
Electrostatic Control & Manipulation of Materials for Containerless Processing		MDAP Geology	
179-20-56	W81-70368	155-50-01	W81-70485
Fusion Target Technology Study		Advanced CCD Camera Development	
179-20-57	W81-70369	157-01 01	W81-70486
Acoustic Containerless Experiment System (ACES)		Instrument Definition	
179-70-10	W81-70370	157 03 01	W81 70487
Infrared Detector Materials Preparation		Radio Astronomy	
179-80-10	W81-70372	188-41 55	W81 70507
Glass Research		Gamma Ray Astronomy	
179-80-30	W81-70373	188 46 57	W81 70511
Bioseparation		Optical Astronomy	
179-80-80	W81-70374	198 41 71	W81 70525
Technical Consultation Services		Infrared Astronomy	
643-10-01	W81-70375	198 41 72	W81-70526
Communication Satellite Application Systems		Planetary Infrared Imaging	
643-10-02	W81-70377	198 41 77	W81 70527
Systems Coordination Support		Earth Based Solar System Observations	
643-10-03	W81-70379	198 41 78	W81-70528
Remote Sensing Frequency Coordination Studies		Planetary Protection Program	
643-10-04	W81-70380	199 50 94	W81-70542
Systems for Underwater Survey and Exploration (SUSE)		Man-Machine Systems	
637-01-02	W81-70381	199 60 60	W81 70543
Seafloor Automated Lander Technology (SALT) (Formerly the High Energy Benthic Boundary Layer Experiment HEBBLE)		Advanced Teleoperation Studies	
637-01-04	W81-70383	199-60 80	W81-70545
OSTA Data Systems Standards and Guidelines		Study of Large Deployable Antennas for Astronomy Applications	
656-13-10	W81-70390	358 78 60	W81 70553
ADS Ocean Pilot System Project		Radio Metric Analysis Demonstration and Instrumentation Development	
656 13-40	W81-70394	310-10 60	W81 70575
ADS Pilot Geosciences Information Network Development		VLBI Development and Analysis	
656 13-70	W81-70396	310-10 61	W81 70576
Applications Data Base Management System (ADBMS)		Frequency and Timing Research	
656 31 02	W81-70397	310-10 62	W81 70577
Automated Mosaicking for Geocoded Data Bases		Navigation Technology Development	
656 33-01	W81-70398	310-10 63	W81 70578
Registration of Radar and Other Data		X-Band Uplink Development	
656 45-02	W81-70399	310 20 64	W81 70583
Synthetic Aperture Radar Processor		Antenna Systems Development	
656 62-01	W81-70400	310 20 65	W81 70584
Commercial Fisheries Ocean Forecast Demonstration		Radio Systems Development	
663 90-03	W81-70401	310 20 66	W81 70585
Laser/VLBI Propagation Medium Analysis		Telemetry Technology Development	
676 59-37	W81-70408	310 20 67	W81 70586
Radar Spectrometer		Station Monitor and Control Technology	
677 27-04	W81-70414	310 30 68	W81-70587
NASA/Geosat Test Case Study		RFI Systems Technology	
677-41-02	W81-70418	310 30 69	W81-70588
Rock Type/Microwave Techniques (Imaging Radar Geology)		High Speed Signal Processing Research	
677 41-04	W81-70419	310 30-70	W81-70589
High Spectral Resolution Remote Sensing		Network Data Processing Development	
677-41-08	W81-70420	310 40 72	W81 70595
Geological Mapping Kilauea Caldera Stratigraphy		Network Productivity Research	
677-41-09	W81-70421	310 40 73	W81 70596
Pipeline/Nuclear Plant Engineering Geology		Arrayed Network Technology	
677-44-01	W81-70428	310 40 74	W81 70597
Aircraft Thermal Infrared Scanner		Lyndon B Johnson Space Center Houston Tex	
677 47-01	W81-70432	Aircraft Controls	Electromechanical Actuator
NASA Airborne Imaging Radar Facility		505 34 37	W81 70053
677-47-03	W81-70434	Aircraft Fire Safety and Testing	
Seasat Digital SAR Processing (Non Renewable Resources)		505 44 27	W81 70111
677-48-01	W81-70435	Fire Systems Full Scale Test	
Seasat Digital SAR Processing (Renewable Resources)		534 05 17	W81-70166
677 76-01	W81-70436	Advanced Manned Vehicle Onboard Propulsion Technology	
Planetary Geology		506 52 17	W81-70181
151 01-07	W81-70440	Refining of Nonterrestrial Materials	
Petrology Lab		506 53 17	W81-70191
153-02-70	W81-70448	Advanced Carbon-Carbon Stand-Off Panel	
Planetary Dynamics		506 53 37	W81-70197
153-05-70	W81-70450	Orbital Energy Storage and Power Systems (H2/O2)	
Planetary Synthesis		506 55 57	W81-70238
153-06-70	W81-70451	Advanced Synthetic Aperture Radar Technology	
Radar Studies		506 61 37	W81-70257
153 07 70	W81-70453	Thermal Management for On-Orbit Energy Systems	
Planetary Atmospheres Composition and Structure		506 62 67	W81-70267
154 10 80	W81-70458	ACIP (Aerodynamic Coefficient Identification Package)	
Dynamic Radiative Interaction		506 63 27	W81-70270
154 20 80	W81-70461	OEX (Orbiter Experiments) Project Support	
Clouds Particulates and Ices		506-63 31	W81 70271
154-30 80	W81-70463	In Situ Instrumentation for Developing Nuclear Waste Isolation Sites	
Radiative Transfer in Cloudy Atmosphere		775 16 27	W81-70298
154-40-80	W81-70464	Regenerative Fuel Cell/Hydrogen/Halogen	
Atoms and Molecular Properties		776 91 17	W81 70299
154-50-80	W81-70466	Waste Heat Automotive Air Conditioner	
Aeronomy Theory and Analysis		778 48 17	W81 70312
154-60-80	W81-70468	In Situ Measurements of Stratospheric Ozone and Total Chlorine	
Aeronomy Energy Deposition		147-10 01	W81 70353
154-70-80	W81-70470		

L

Langley Research Center Hampton Va	
Computational Fluid Dynamics	
505 31 13	W81 70002
Turbulent Drag Reduction	
505 31 23	W81 70004
Airfoil Development	
505 31 33	W81 70006
Configuration Aerodynamics	
505 31 43	W81 70008
Experimental Methods and Instrumentation	
505 31 53	W81 70011
Full Space Reynolds Number Test Technology	
505 31 63	W81 70013
Post Spill Liquid Hydrogen Behavior	
505 31 70	W81 70014
Applied Mathematics	
505 31 83	W81 70015
Propulsion Noise Research	
505 32 03	W81 70018
Propulsion System Integration	
505 32 13	W81 70021
Hypersonic Propulsion Research	
505 32 93	W81-70030
Advanced Aluminum Alloys	
505 33 13	W81 70032
Life Prediction for Composite Materials	
505 33-23	W81 70035
Composites	
505 33-33	W81 70038
Loads Aeroelasticity and Structural Dynamics	
505 33 53	W81 70040
Aeronautical Structural Design Methods	
505 33 63	W81 70044
High Temperature Aeronautical Structures	
505 33-73	W81-70046

Cockpit Avionics Generic	W81-70048	Intelligent Systems Research	W81 70222	High Temperature Structures	W81 70045
505 34-23		Advanced Spacecraft Pointing and Control Systems	W81-70224	Electronic Aircraft Engine Control	W81 70050
Aircraft Controls Theory and Techniques	W81 70051	Advanced Radiant Energy Conversion		505 34 32	W81 70050
505-34-33		Solar Cell Research	W81 70227	Fund for Independent Research (Aeronautics)	W81 70062
Integration and Interfacing Technology	W81-70054	Fund for Independent Research (Space)	W81 70234	505-36-22	W81 70067
505 34-43		506-55-13	W81-70246	Graduate Research Program in Aeronautics	
Human Response to Noise	W81-70055	Solar Cell Research	W81-70254	Advanced General Aviation Propulsion Research	W81-70073
505-35-13		Instrument Pointing Systems	W81 70258	505 41 22	
Crew Interaction with Advanced Flight Systems	W81 70057	NASA End-to-End Data System Information Adaptive System	W81 70260	Low Speed Propeller Research	W81 70076
505 35 23		506-61 53	W81-70264	505-41 52	W81 70076
Application of Flight Simulation Technology	W81-70060	Large Space Structures Systems Technology	W81-70269	V/STOL Propulsion Research	W81-70087
505 35 33		Space Shuttle Development Support	W81 70269	505 42 62	W81-70087
Fund for Independent Research (Aeronautics)	W81-70063	Shuttle Entry Air Data System (SEADS)	W81 70272	Combat Veh & Missile Aerodyn & Flight Dyn R & T	W81 70094
505 36-13		506-63-32	W81 70272	505-43 22	
Graduate Program in Aeronautics	W81-70068	Shuttle Infrared Leeside Temperature Sensing (SILTS)	W81 70273	Aviation Meteorology Research	
505-36-23		506-63 34	W81 70273	505 44-12	W81 70101
General Aviation Aerodynamics and Handling Qualities	W81-70068	Shuttle Upper Atmospheric Mass Spectrometer (SUMS)	W81 70276	Aviation Operations Safety Technology	W81 70108
Technology	W81-70071	506-63 37	W81-70276	505 44-22	W81 70108
505 41 13		Information Systems for Earth Observations for Space	W81 70276	Commercial Aircraft Fuel Savings	W81 70115
General Aviation Crash Dynamics	W81-70074	540-01-13	W81 70277	505-44-32	W81 70115
505 41-33		Technology Requirements of Future Integrated Space Transportation Systems	W81 70277	Materials for Advanced Turbine Engines (MATE)	W81 70117
General Aviation Propeller Noise Reduction	W81 70075	540-03 13	W81-70284	510 53 12	W81 70117
505-41 43		Semiconductor Materials Growth in Low g Environment	W81-70284	Aeroelasticity of Turbine Engines	
General Aviation Avionics and Control Technology	W81-70077	542 03-30	W81 70294	510-55-12	W81-70119
505 41 63		Long Duration Exposure Facility	W81 70294	Turbine Engine Hot Section Technology (HOST)	
General Aviation Single Pilot IFR Systems	W81-70079	542-04-13	W81 70296	510-57-12	W81 70120
505-41-73		Radiation Budget and Aerosol Studies	W81 70296	Advanced Low Emission Combustor (ALEC)	
Aerial Applications Aerodynamics and Systems Interaction	W81 70080	146-10 06	W81-70326	511-55 12	W81 70121
505-41 83		Application of Remote Measurement Techniques to Tropospheric Air Quality Monitoring	W81-70326	Helicopter Transmission Technology	
Rotocraft Structures Vibration Aeroelasticity and Acoustics	W81-70082	146-20-10	W81 70328	511 58 12	W81-70122
505 42 13		Airborne Water Vapor Lidar	W81 70328	Broad Property Fuels Technology	
Rotocraft Aerodynamics Scale Modeling	W81 70084	146-30-03	W81 70332	511-59-12	W81 70123
505-42-23		Microscale Ocean Surface Dynamics	W81 70332	Propulsion Systems for Small Transports	
Flight Dynamics	W81 70084	146-40 05	W81-70333	530-04 12	W81 70129
505-43-13		Microwave Remote Sensing for Ice Processes Research	W81-70333	Advanced Propulsion System Concepts	
Combat Vehicle and Missile Aerodynamics and Flight Dynamics	W81 70091	146 40 06	W81-70336	530-05 12	W81 70131
505 43 23		Advanced Ocean Sensor Systems Development	W81-70336	QPLT Systems Technology	
Interagency and Industrial Assistance and Testing	W81-70095	146 40 13	W81 70340	532 02 12	W81 70135
505-43-33		Coastal and Estuarine Dynamic Processes Research	W81 70340	V/STOL Propulsion System Technology	
Aviation Meteorology Research Severe Storms	W81 70097	146-40-15	W81 70341	532-05-12	W81 70140
505-44-13		Stratospheric Measurement Program Activities	W81 70341	Advanced Rotorcraft Propulsion Technology	
Aviation Safety Technology- Flight Safety	W81 70102	146 60 01	W81 70347	532-06 12	W81 70141
505-44 23		Environmental Monitoring Research Satellite Mission Studies	W81 70347	SCR Propulsion Technology	
Aircraft Landing Systems Efficiency Improvements	W81 70109	146 60-02	W81-70349	533 01 32	W81 70146
505 44 33		Atmospheric Lidar System Definition	W81-70349	Propulsion System/Airframe Integration Technology	
Integrated Programs for Aerospace-Vehicle Design (IPAD)	W81-70116	146 60-03	W81 70350	535 01-12	W81 70148
510-54-13		Evaluation of Advanced Sensor Concepts for Satellite Monitoring of the Stratosphere	W81 70350	Energy Efficient Engine Project	
General Aviation System Technology Studies	W81 70118	147-10-02	W81 70355	Variable Cycle Engine Technology	
530-01 13		Stratospheric Theoretical Studies and Science Definition Activities	W81 70355	535 02 12	W81 70167
Long Haul Transport Aircraft Systems Studies	W81 70126	147 30 01	W81-70361	Advanced Turboprop Program	
530 04 13		Laser Heterodyne Spectrometer (LHS) Brassboard	W81-70361	535 03 12	W81 70169
Advanced Rotorcraft Systems Technology Materials and Noise	W81-70130	147 40 01	W81-70366	Liquid-Chemical Propulsion Technology	
532 06 13		Infrared Detector Materials Research	W81-70366	506 52 12	W81 70180
SCR-Materials and Structures	W81-70142	179 80-10	W81 70371	Materials Science	
533 01-13		Systems for Marine Environment Prediction (Airborne Active/Passive Microwave)	W81 70371	506-53 12	W81-70189
SRC - Aerodynamic Performance Technology	W81 70144	637 01-03	W81 70382	Electrophysics	
533-01-43		Lewis Research Center Cleveland, Ohio		506-54-42	W81 70208
SCR Airframe/Propulsion System Interactions	W81 70147	Propulsion Noise Research		Advanced Energetics	
533-01-63		Inlet Nozzle and Propeller Research	W81 70017	506-55 12	W81 70226
Decoupler Pylon Flight Demonstration	W81-70149	Fan Compressor and Turbine Research	W81 70020	Electro Propulsion Technology	
533 02 73		Combustion and Emissions Reduction Research	W81 70022	506 55 22	W81 70230
Highly Maneuvering Aircraft Technology	W81-70155	Power Transfer Research	W81 70023	Ion Thruster Research and Ion Beam Applications	
533 03 13		Computational Fluid Mechanics for Turbomachinery	W81 70024	506 55 32	W81 70231
Laminar Flow Control	W81-70156	505-32 52	W81 70025	Solar Cell Technology	
534-01-13		Engine Dynamics and Controls Research	W81 70026	506 55 42	W81 70233
Energy Efficient Transport	W81 70157	Fuels Research	W81-70027	Electrochemical Energy Conversion and Storage	
534-02-13		Propulsion Instrumentation Research	W81-70027	506-55-52	W81 70236
Composite Components Technology	W81 70160	505 32-82	W81 70028	Power Systems Management and Distribution	
534-03-13		Advanced Engine System Concepts	W81 70028	506-55 72	W81 70240
Large Composite Primary Aircraft Structures (LCPAS) - Key Technology	W81 70162	505 32 92	W81 70029	Fund for Independent Research (Space)	
534 03 33		Metallic/Ceramic Materials	W81 70026	506 56 12	W81 70245
Terminal Configured Vehicle Program	W81-70163	505-33 12	W81-70031	High Efficiency Technology for Microwave Amplifiers	
534 04-13		Life Prediction	W81-70031	506-61-22	W81 70250
Advanced Turboprop- Interior Noise	W81-70164	505 33 22	W81 70034	Earth Orbital Platform Systems Auxiliary Electric Propulsion for Spacecraft Systems	
535 03-13		Composites for Advanced Space Systems	W81 70034	506 62 62	W81 70266
Space Vehicle Aerothermodynamics and Configuration Technology	W81 70170	505 33-22	W81 70034	Space Propulsion and Power System Studies	
506 51-13		Planetary Probe Technology	W81 70174	540-02 12	W81 70281
506-51 23		Aerodynamic/Aerothermodynamic Flight Data Analysis	W81 70176	Satellite Communications Technology	
506 51 33		505 33 23	W81 70178	541 02 12	W81 70287
Composites for Advanced Space Systems	W81-70192	Propulsion Instrumentation Research	W81-70027	Cryogenic Fluid Management	
506 53 23		505 33-22	W81 70028	542-03 52	W81-70295
Thermal Protection Systems for Earth-to-Orbit STS	W81 70196	Advanced Engine System Concepts	W81 70028	Flight Test of an Ion Auxiliary Propulsion System (IAPS)	
506 53 33		505 32 92	W81 70029	542-05-12	W81-70297
Advanced Space Structures	W81 70199	Metallic/Ceramic Materials	W81 70026	Combustion Technology for Power Generation	
506 53-43		505-33 12	W81-70031	778 45 12	W81 70304
Failure and Thermal Analysis	W81 70200	Life Prediction	W81-70031	Power Generation Concepts and Applications	
506 53-53		505 33 22	W81 70034	778 46 12	W81 70306
Loads Dynamics and Aeroelasticity	W81-70202	Composites for Propulsion Components	W81 70034	String Engine Components and System Concepts	
506-53 63		505 33-32	W81-70037	778-46-22	W81 70307
Quantum Electronics Devices and Sensors	W81-70209	Loads Dynamics and Aeroelasticity	W81 70039	Great Lakes Water Quality Research	
506 54-43		505 33 52	W81 70039	Technical Consultation Services	
Advanced Electronic Components	W81 70216	Integrated Analysis and Synthesis	W81 70043	643 10 01	W81 70376
506 54-63		505 33 62	W81 70043	Communications Satellite Applications Systems	
Automated Decision Making and Problem Solving	W81 70219			643 10 02	W81 70378
506 54-73				30/20 GHz Wideband System Definition	
				650 20 16	W81 70384
				GHz Wideband Communications Satellite Project Definition	
				650-60 18	W81 70385

RESPONSIBLE NASA ORGANIZATION INDEX

Wallops Flight Center, Wallops Island, Va

30/20 GHz Spacecraft Multibeam Antenna Technology
650 60-20 W81 70386
Satellite Switching and Processing Systems
650 60-21 W81 70387
Communications System Components
650 60-22 W81 70388
Communications Systems Breadboard
650 60 23 W81 70389

M

Marshall Space Flight Center Huntsville, Ala
Aviation Meteorology Research Basic Atmospheric
Processes
505-44 19 W81 70106
Aviation Operations Safety Technology Applied Laser
Technology
505 44-29 W81 70113
Advanced Reusable Main Engine Technology
506 52 19 W81 70182
Plume Characterization

506 52 39 W81 70186
Long Term Space Environmental Effects on Materials
506 53 29 W81 70194
Thermal Control System Technology
506 53 39 W81 70198
Space Vehicle Dynamics
506 53 69 W81 70206
Signal Processing and Detection High Density Circuit
Technology
506 54-59 W81 70214
Solid State Research Superconducting Circuitry
506 54 69 W81 70218
Laser Propulsion
506 55 19 W81 70229
Multi KW Low Cost Earth Orbital Systems
506 55 79 W81 70243
Fund for Independent Research
506 56 19 W81 70248
Utilization of Space for Science Experiments
506 56 29 W81 70249
NASA End-to-End Data System (NEEDS) Data Base
Management/Archival Mass Memory
506 61 59 W81 70263
Space Applications of Automation Robotics and Machine
Intelligence Systems (ARAMIS)

540 02 19 W81-70283
Shuttle Derived Vehicle Technology Requirements
540-03 19 W81-70285
Shuttle Operational Flight Test of the Solar Electric
Propulsion Solar Array
542 03 04 W81-70290
Tribological Experiments in Zero Gravity

542 03 27 W81-70293
Integrated Modular Solar Energy Systems (Small
Dispersed Solar Energy Systems Applications)

776 91 19 W81-70300
Ocean Thermal Energy Conversion Study and

Assessment
776 91 40 W81-70302
Solar Ranking Cycle Applications Study

776 91 59 W81-70303
Coal Conversion Processes and Systems

778 47 29 W81-70310
Advanced Energy Technology for Utilities

778 50 29 W81-70315
Commercial Prototype Fusion-Welding System

(Computer Controlled/Closed Circuit Television Arc
Guidance)

141 95-01 W81-70318
Commercialization an Orbital Tube Flaring System

141 95 01 W81-70319
Prosthetic Urinary Sphincter Control Valving System

141 95 02 W81-70320
Ocular Screening System

141 95-02 W81-70321
Global Weather Research

146 30-02 W81-70331
Severe Storms and Local Weather Research

146 50 02 W81 70345
Superconducting Gravity Gradiometer

676 59-33 W81 70406
Shuttle Time and Frequency Transfer Experiment
(STIFT)

676-59 41 W81 70409
Particle and Particle Field Interactions

170 36 55 W81 70490
Development of Experiments and Hardware for Solar
Physics Research

170-38 51 W81 70495
Ground Based Observations of the Sun

170-38 52 W81 70498
UV and Optical Astronomy

188-41 51 W81 70501
Particle Astrophysics

188-46 56 W81 70508
X Ray Astronomy Time Variability and Polarimetry

188-46 59 W81 70512
Interdisciplinary Space Science Research

188 48 51 W81 70514
Low Gravity Superfluid Helium Advanced Technology
Development

188-78 51 W81 70515

Advanced Mission Studies
188 78-60 W81 70517
Cometary Observation and Theory
196 41-30 W81 70518
Space Plasma Physics
356 36-01 W81 70548
Advanced Mission Study - Solar X-Ray Pinhole Satellite
and Long Focal Length Coronagraph
356 38-01 W81 70549
Spacelab Science Payloads Definition ATD General
356-78-01 W81 70550
Spacelab Science Payload Definitions ATD General
358-78-01 W81 70552
Magnetospheric Data Analysis
385-36-01 W81-70555
Data Analysis Solar Physics
385-38-01 W81 70560

N

National Aeronautics and Space Administration
Washington D C
Interdisciplinary Research in Composite Structures
505-33-60 W81-70042
CFD Training Program
505-36-20 W81-70065
Chemical Propulsion Research Support
506-52-30 W81-70184
Space Engineering
506-53-10 W81-70187
High Density Circuit Technology Electronic Devices
506-54 60 W81-70215
Space Systems and Planning Analysis
540-04-10 W81-70286
Ground Based Optical Planetary Astronomy
196-41 80 W81-70529
Astronomical Optical Instrument Development
196-41 81 W81-70530
Laboratory Supporting Studies (Astronomy)
196-41 84 W81-70531
Ground Based Radio and Radar Planetary Astronomy
196-41 85 W81-70532
Theoretical Planetary Astronomy
196-41 85 W81-70533

National Space Technology Labs Bay Saint Louis Miss
Integration of VIS IR NW Data
677-21 06 W81-70410
Surface Mine Rehabilitation Inventory and Monitoring
677-21 20 W81-70411
Very Low Cost Data System 16 Bit
Microprocessor Driven ELAS
677-76 04 W81-70437

W

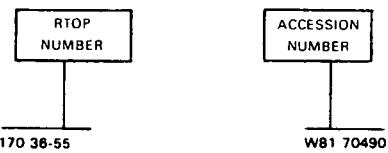
Wallops Flight Center Wallops Island Va
General Aviation Aircraft Aerodynamics and Flight
Dynamics
505 41 18 W81 70072
General Aviation Avionics and Controls
505 41 68 W81-70078
Aviation Meteorology Research Atmospheric Dynamics
& Measurement Tech
505 44 18 W81 70105
Aviation Operations Safety Technology Wind Shear and
Collision Avoidance
505 44 28 W81 70112
Airborne Experiment Platforms
530 02 18 W81 70128
Wallops Flight Center Research Airport Support
534 04 18 W81 70165
Advanced Ocean Sensor Systems Development
146 40 13 W81 70339
Improved Measurement and Calibration Techniques for
Stratospheric Trace Species
146 60 01 W81 70348

RTOP NUMBER INDEX

FISCAL YEAR 1981

RTOP Summary

Typical RTOP Number Index Listing



This section may be used to identify the RTOP accession number of reports covered in this journal. Thus this section of this index may be used to locate the bibliographic citations and technical summaries in the Summary Section. The RTOP numbers are listed in ascending number order.

RTOP NUMBER	ACCESSION NUMBER
170 36-55	W81 70490
141-20 11	W81 70316
141-20 21	W81 70317
141 95 01	W81-70318
141 95 02	W81 70319
141 95 02	W81 70320
146 01-00	W81 70321
146-10-02	W81 70322
146-10 03	W81 70323
146-10 04	W81 70324
146-10 06	W81 70325
146-20 08	W81 70326
146-20 10	W81 70327
146-20 23	W81-70328
146-30 02	W81 70329
146 30 03	W81-70330
146-40-05	W81 70331
146-40-06	W81 70332
146-40-07	W81 70333
146-40-12	W81 70334
146-40-13	W81 70335
146-40 15	W81 70336
146-40 18	W81 70337
146-50 02	W81 70338
146-60 01	W81 70339
146-60 02	W81 70340
146-60 03	W81 70341
146-60 03	W81-70342
146-60 18	W81-70343
146-50 02	W81-70344
146-60 01	W81-70345
146-60 02	W81-70346
146-60 03	W81-70347
146-60 03	W81-70348
146-60 03	W81-70349
146-60 03	W81-70350
146-90 03	W81 70351
147-10 01	W81 70352
147-10 02	W81 70353
147-10 03	W81 70354
147-20 01	W81 70355
147-20 01	W81 70356
147-20 01	W81 70357
147-20 03	W81 70358
147-30 01	W81 70359
147-30 02	W81-70360
147-30 02	W81-70361
147-30 02	W81-70362
147-30 02	W81-70363
147-40-01	W81-70364
151-01-60	W81 70365
151-01-70	W81 70439
151-02-60	W81 70440
152-01 40	W81 70441
152-02 40	W81 70442
152-04 40	W81 70443
152-05 40	W81 70444
153-01 60	W81 70445
153-02 40	W81 70446
153-02 70	W81 70447
153-03 42	W81 70448
153-05 70	W81 70449
	W81 70450

153-06-70	W81 70451	199 10 20	W81 70535
153-07-40	W81 70452	199 10 30	W81 70536
153-07-70	W81 70453	199 10 41	W81-70537
153-08-50	W81 70454	199 20-00	W81 70538
153-08-60	W81 70455	199-20 50	W81 70539
153-10-40	W81 70456	199 20-60	W81 70540
154-10-80	W81 70457	199-20-70	W81 70541
154 20-80	W81 70459	199-50-94	W81 70542
154-30-80	W81 70460	199 60-60	W81 70543
154-40-80	W81 70461	199-60-71	W81 70544
154-50-80	W81 70462	199-60 80	W81-70545
154-60-80	W81 70463	199-70 31	W81-70546
154-70-80	W81-70464	199-90 71	W81-70547
154-75-80	W81-70466	310 10 23	W81 70572
154-80-80	W81-70467	310 10 26	W81-70573
154-90-80	W81-70468	310 10 42	W81-70574
154-95-80	W81-70469	310 10-60	W81 70575
155-01-01	W81-70470	310-10-61	W81 70576
155-20-40	W81 70471	310-10-62	W81-70577
155-20-70	W81 70472	310-10 63	W81-70578
155-41-80	W81 70473	310-20 27	W81-70579
155 50-01	W81 70474	310 20 33	W81 70580
155 50-01	W81 70475	310-20 38	W81-70581
155 50-01	W81 70476	310 20 46	W81 70582
155 50-01	W81 70477	310 20 64	W81 70583
155 50-01	W81 70478	310 20 65	W81 70584
155 50-01	W81 70479	310 20 66	W81 70585
155 50-01	W81 70480	310 20 67	W81 70586
155 50-01	W81-70481	310 30 68	W81 70587
155 50-01	W81-70482	310 30 69	W81 70588
155 50-01	W81-70483	310 30 70	W81 70589
155 50-01	W81-70484	310 40 26	W81 70590
155 50-01	W81-70485	310-40-37	W81 70591
155 50-01	W81 70486	310-40-45	W81-70592
155 50-01	W81-70487	310-40 46	W81 70593
155 50-01	W81 70488	310 40-49	W81-70594
155 50-01	W81 70489	310-40 72	W81 70595
155 50-01	W81 70490	310-40-73	W81-70596
155 50-01	W81 70491	310-40-74	W81 70597
155 50-01	W81 70492	356-36 01	W81 70548
155 50-01	W81 70493	356-36 01	W81 70549
155 50-01	W81 70494	356-78 01	W81 70550
155 50-01	W81 70495	358-41 06	W81 70551
155 50-01	W81 70496	358 78 01	W81 70552
155 50-01	W81 70497	358 78 60	W81 70553
155 50-01	W81 70498	385-36 01	W81 70554
155 50-01	W81 70499	385-36 01	W81 70555
155 50-01	W81 70500	385 36 02	W81 70556
155 50-01	W81 70501	385 36 04	W81 70558
155 50-01	W81 70502	385 38 01	W81-70559
155 50-01	W81 70503	389 41-01	W81-70561
155 50-01	W81 70504	389 46-01	W81-70562
155 50-01	W81 70505	389-46-03	W81 70563
155 50-01	W81 70506	389-46-04	W81-70564
155 50-01	W81 70507	505 31 11	W81-70001
155 50-01	W81 70508	505 31 13	W81 70002
155 50-01	W81 70509	505 31 21	W81 70003
155 50-01	W81 70510	505 31 23	W81 70004
155 50-01	W81 70511	505 31 31	W81 70005
155 50-01	W81 70512	505 31 33	W81 70006
155 50-01	W81 70513	505 31 41	W81 70007
155 50-01	W81 70514	505 31 43	W81 70008
155 50-01	W81 70515	505 31 44	W81 70009
155 50-01	W81 70516	505 31 51	W81 70010
155 50-01	W81 70517	505 31 53	W81 70011
155 50-01	W81 70518	505 31 54	W81 70012
155 50-01	W81 70519	505 32 05	W81-70019
155 50-01	W81 70520	505 32 12	W81-70020
155 50-01	W81 70521	505 32-13	W81-70021
155 50-01	W81 70522	505 32-22	W81 70022
155 50-01	W81 70523	505-32-32	W81 70023
155 50-01	W81 70524	505-32-42	W81 70024
155 50-01	W81 70525	505-32-52	W81-70025
155 50-01	W81 70526	505-32 62	W81 70026
155 50-01	W81 70527	505-32 72	W81 70027
155 50-01	W81 70528	505-32 82	W81 70028
155 50-01	W81 70529	505 32 92	W81 70029
155 50-01	W81 70530	505-32 93	W81 70030
155 50-01	W81 70531	505 33 12	W81 70031
155 50-01	W81 70532	505 33 13	W81 70032
155 50-01	W81 70533	505-33 21	W81 70033
155 50-01	W81 70534	505-33 22	W81 70034

RTOP NUMBER INDEX

505-33 23	W81-70035	506-53 33	W81 70196	532 06-12	W81-70141
505-33 31	W81 70036	506-53 37	W81-70197	532-06-13	W81-70142
505-33 32	W81 70037	506-53 39	W81-70198	533-01-11	W81 70143
505-33-33	W81 70038	506 53 43	W81-70199	533-01-13	W81 70144
505-33-52	W81 70039	506-53 53	W81-70200	533-01-14	W81 70145
505-33-53	W81 70040	506-53 55	W81-70201	533-01-32	W81 70146
505-33-54	W81 70041	506-53 63	W81 70202	533 01-62	W81-70147
505-33 60	W81 70042	506-53 64	W81-70203	533-01 63	W81-70148
505-33 62	W81 70043	506-53-65	W81-70204	533-02 14	W81 70149
505-33-63	W81 70044	506-53 66	W81-70205	533-02 24	W81 70150
505-33-72	W81 70045	506-53 69	W81-70206	533-02-34	W81 70151
505-33-73	W81 70046	506-53 69	W81-70207	533-02 44	W81 70152
505 34 11	W81 70047	506-54-41	W81-70208	533-02 64	W81 70153
505-34 23	W81-70048	506 54 42	W81 70209	533 02 73	W81 70154
505-34 31	W81 70049	506 54-43	W81 70210	533 03 13	W81 70155
505-34 32	W81-70050	506 54-45	W81 70211	534 01 13	W81 70156
505 34 33	W81-70051	506 54 46	W81 70212	534 01-14	W81 70158
505-34 34	W81-70052	506 54 55	W81 70213	534 02-11	W81 70159
505 34 37	W81-70053	506 54 56	W81 70214	534 02-13	W81 70160
505-34 43	W81-70054	506 54 59	W81 70215	534 02-14	W81 70161
505 35 13	W81-70055	506 54 60	W81 70216	534 03-13	W81 70162
505 35 21	W81-70056	506 54 63	W81 70217	534 03-33	W81 70163
505 35 23	W81-70057	506 54 65	W81 70218	534 04-13	W81 70164
505 35 24	W81-70058	506 54 69	W81 70219	534 04-18	W81 70165
505 35 31	W81-70059	506 54 73	W81 70220	534-05-17	W81 70166
505 35 33	W81 70060	506-54 75	W81 70221	535-01-12	W81 70167
505 36 11	W81 70061	506-54 76	W81 70222	535-02-12	W81-70168
505 36 12	W81 70062	506-54 83	W81-70223	535-03-12	W81 70169
505-36 13	W81 70063	506-54 85	W81-70224	535-03 13	W81-70170
505-36-14	W81 70064	506-54-93	W81-70225	535-03-14	W81-70171
505-36-20	W81 70065	506-54-95	W81-70226	536-01 11	W81-70172
505-36-21	W81 70066	506-55-12	W81-70227	540-01 13	W81-70227
505-36-22	W81-70067	506 55 13	W81-70228	540-01 15	W81-70278
505-36-23	W81-70068	506 55 15	W81-70229	540 01 16	W81 70279
505-36 24	W81 70069	506 55 19	W81-70230	540 02 11	W81-70280
505-41 11	W81-70070	506 55-22	W81-70231	540 02 12	W81-70281
505-41 13	W81-70071	506 55 32	W81-70232	540 02 15	W81-70282
505-41 18	W81-70072	506 55 35	W81 70233	540-02 19	W81-70283
505-41 22	W81-70073	506 55 42	W81 70234	540 03 13	W81 70284
505 41 33	W81 70074	506 55 43	W81 70235	540 03 19	W81-70285
505 41 43	W81-70075	506 55 45	W81 70236	540 04-10	W81 70286
505 41 52	W81 70076	506-55 52	W81 70237	541 02 12	W81 70287
505 41 63	W81 70077	506-55 55	W81 70238	541 02 15	W81 70288
505 41 68	W81 70078	506-55 57	W81 70239	542 03-01	W81 70289
505 41 73	W81 70079	506-55 65	W81 70240	542 03-04	W81 70290
505 41 83	W81 70080	506-55 72	W81-70241	542 03-13	W81 70291
505 42 11	W81 70081	506-55 75	W81 70242	542 03-20	W81 70292
505-42 13	W81 70082	506-55 76	W81 70243	542 03-27	W81 70293
505 42 21	W81 70083	506-55 79	W81-70244	542 03-30	W81 70294
505 42 23	W81 70084	506-56 11	W81-70245	542 03-52	W81 70295
505 42 31	W81 70085	506-56-12	W81-70246	542-04-13	W81 70296
505 42 51	W81 70086	506-56-13	W81-70247	542-05-12	W81 70297
505-42 62	W81-70087	506 56-16	W81-70248	637-01-02	W81 70381
505-42 71	W81-70088	506-56-19	W81-70249	637 01-03	W81 70382
505-42-74	W81-70089	506 56-29	W81-70250	637-01-04	W81 70383
505-43-11	W81-70090	506-61 22	W81-70251	643 10-01	W81 70375
505-43 13	W81-70091	506 61-25	W81 70252	643 10-02	W81 70376
505-43-14	W81-70092	506 61-26	W81 70253	643 10-02	W81 70377
505-43-21	W81-70093	506 61-31	W81 70254	643 10-02	W81-70378
505-43-22	W81-70094	506 61 33	W81-70255	643 10 03	W81-70379
505-43-23	W81-70095	506 61 35	W81 70256	643 10 04	W81-70380
505-43-31	W81-70096	506 61 36	W81 70257	650 20 16	W81-70384
505-43-33	W81-70097	506 61 37	W81 70258	650 60 18	W81-70385
505-43-34	W81 70098	506 61 43	W81 70259	650 60 20	W81-70386
505-43-44	W81 70099	506 61 46	W81 70260	650 60 21	W81 70387
505-43-54	W81 70100	506 61 53	W81 70261	650 60 22	W81 70388
505-44 12	W81-70101	506 61 55	W81 70262	650 60 23	W81-70389
505-44 13	W81-70103	506 61 59	W81 70263	656 13 10	W81-70390
505-44 15	W81 70104	506 62 43	W81 70264	656 13 20	W81-70391
505 44 18	W81-70105	506 62 55	W81 70265	656 13 30	W81-70392
505-44 19	W81 70106	506 62 62	W81 70266	656 13 40	W81-70393
505 44 21	W81 70107	506 62 67	W81 70267	656 62 01	W81-70394
505 44 22	W81 70108	506-63 11	W81 70268	663 90 03	W81-70401
505-44 23	W81 70109	506-63 13	W81 70269	666 10 10	W81-70402
505-44 25	W81 70110	506-63 27	W81 70270	666 31 02	W81-70396
505 44 27	W81 70111	506-63 31	W81 70271	666 33 01	W81-70398
505 44 28	W81 70112	506-63 32	W81 70272	666 45 02	W81-70399
505 44 29	W81 70113	506-63 34	W81 70273	666 62 01	W81-70400
505 44 31	W81 70114	506-63 35	W81 70274	666 90 03	W81-70401
505 44 32	W81 70115	506-63 36	W81 70275	676 30 01	W81-70403
505 44 33	W81 70116	506-63 37	W81 70276	676 40 01	W81-70404
506 51 11	W81 70173	510-53 12	W81 70277	676 59 30	W81-70405
506 51 13	W81 70174	510-54 13	W81 70118	676 59 33	W81-70406
506 51 21	W81 70175	510-55 12	W81 70119	677 22 12	W81-70413
506 51 23	W81-70176	510-57 12	W81 70120	677 27 04	W81-70414
506 51 31	W81 70177	511-55 12	W81 70121	677 29-04	W81 70415
506 51-33	W81-70178	511-58 12	W81 70122	677 29 06	W81 70416
506 51 34	W81 70179	511-59 12	W81-70123	677 21 06	W81-70410
506 52-12	W81-70180	512-54 11	W81 70124	677 21 20	W81-70411
506-52-17	W81-70181	512-54-14	W81 70125	677 21 22	W81-70412
506-52 19	W81-70182	530-01-13	W81 70126	677 22 12	W81-70413
506-52-25	W81-70183	530-02-11	W81 70127	677 29-04	W81-70414
506-52-30	W81-70184	530-02-18	W81 70128	677 29 06	W81 70416
506-52-35	W81-70185	530-04-12	W81-70129	677 41-02	W81-70417
506-52-39	W81-70186	530-04-13	W81 70130	677 41 02	W81-70418
506-53-10	W81-70187	530-05-12	W81-70131	677 41-02	W81-70418
506-53-11	W81-70188	531-01-11	W81-70132	677 41 04	W81-70419
506-53-12	W81-70189	532 01-11	W81-70133	677 41 08	W81 70420
506-53-15	W81-70190	532 02-11	W81-70134	677 41-09	W81-70421
506-53-17	W81-70191	532 02-12	W81-70135	677 41-11	W81 70422
506-53-23	W81-70192	532 03-11	W81-70136	677 41 12	W81-70423
506-53-25	W81-70193	532 04 11	W81-70137	677 42-01	W81-70424
506-53-29	W81-70194	532 05 11	W81 70138	677 42 01	W81-70425
506 53 31	W81 70195	532 05 12	W81 70139	677 43-01	W81 70426
			W81 70140	677 43 03	

RTOP NUMBER INDEX

677-43 05	W81 70427
677-44 01	W81-70428
677-45 01	W81-70429
677-45 03	W81-70430
677-45 04	W81-70431
677-47 01	W81-70432
677-47 02	W81-70433
677-47 03	W81-70434
677-48 01	W81-70435
677-76 01	W81-70436
677-76 04	W81-70437
677-77 01	W81-70438
685-20 06	W81-70565
685-20-08	W81-70566
685-20 11	W81-70567
775-16 27	W81-70298
776-91 17	W81-70299
776-91 19	W81-70300
776-91-35	W81-70301
776-91-40	W81-70302
776-91-59	W81-70303
778-45-12	W81-70304
778-45-35	W81-70305
778-46-12	W81-70306
778-46-22	W81-70307
778-46-35	W81-70308
778-47-15	W81-70309
778-47-29	W81-70310
778-48 15	W81-70311
778-48-17	W81-70312
778-49-15	W81-70313
778 50-15	W81-70314
778 50-29	W81-70315
828 11-36	W81 70568
828 11-38	W81 70569
879 11-41	W81 70571
879 11-46	W81 70570
906 55-00	W81 70598
906-75-00	W81 70599

20 APR 1981 L. A. Schaefer E 080/106/2 5869 11 26

National Aeronautics and
Space Administration

Washington, D.C.
20546

Official Business

Penalty for Private Use, \$300

THIRD-CLASS BULK RATE

Postage and Fees Paid
National Aeronautics and
Space Administration
NASA-451



1 1 RTOP, 031281 S00645BS 810430
MCDONNELL DOUGLAS CORP
ATTN: MCDONNELL LIBRARY, DEPT 022
P O BOX 516
ST LOUIS MO 63166

NASA

POSTMASTER

If Undeliverable (Section 158
Postal Manual) Do Not Return

MCDON
RESEARCH

1100 3⁵